Digitized by the Internet Archive
in 2012 with funding from
University of California, Davis Libraries

http://archive.org/details/reportofstatemin18cali

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON State Mineralogist

REPORT XVIII OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU DURING 1922

CALIFORNIA STATE PRINTING OFFICE
FRANK J. SMITH, Superintendent
SACRAMENTO, 1923

17105

LIBRARY
UNIVERSITY OF CALIFORNIA
DAVIS

CALIFORNIA STATE MINING BUREAU

EXECUTIVE AND TECHNICAL STAFF

FLETCHER HAMILTON
State Mineralogist

W. W. THAYER
Secretary

MINING DIVISION

C. A. Logan, District Mining Engineer	Auburn
C. McK. Laizure, District Mining Engineer	San Francisco
M. A. Newman, District Mining Engineer	Los Angeles
W. Burling Tucker, District Mining Engineer	Redding
Chas. S. Haley, Mining Engineer	San Francisco
Walter W. Bradley, Statistician and Curator	San Francisco
Frank Sanborn, Petrologist	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. E. Collom, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

JANUARY, 1922

REPORT XVIII OF THE STATE MINERALOGIST

INTRODUCTION.

Many years ago the fact was recognized that it would be a good investment for the government to spend time and money as a means of aiding in the development of the nation's natural resources.

Work of this character is done both by federal and state agencies.

The California State Mining Bureau is charged with the duty of giving all possible assistance to those who are engaged in any and all branches of mining in this State.

This assistance is manifested in various ways, advantage of which is not taken by the general public to the extent that might be.

It is also a fact that some of the Bureau's work may have fallen short of its full purpose because it has sometimes been impossible to make the results available to the mining public in usable form or in a timely manner.

With reference to this latter situation, it is a common criticism of many government bureaus that the results of their investigations are so long in preparation that when they appear in print they often represent 'ancient history' and have lost much of their usefulness.

There are valid explanations of this situation, but even so, the fact is acknowledged, and the matter of correcting it has received a great deal of thought by the State Mineralogist and the members of the State Mining Bureau.

In 1919 a progressive change was made by the State Mining Bureau when the State Oil and Gas Supervisor's annual report to the State Mineralogist was issued in monthly chapters. This practice has been followed long enough to prove that the idea behind it was sound.

The Bureau, therefore, is taking an additional step in what is believed to be the right direction by starting with this issue (January, 1922) the monthly chapters of the Annual Report of the State Mineralogist.

The result will be that instead of beginning to correlate material for an annual report after the close of a year, and getting it out in the course of several months, all possible data resulting from any of the Bureau's endeavors will be assembled every thirty days and will be placed in the hands of interested parties in a few *days*. Facts and statements relating to the mining and allied industries will be as of two or three weeks ago instead of 'as of last year or the year before.'

Furthermore, while this new departure is primarily for the purpose of correcting a fault that was inherent in the prescribed system of carrying on work such as that in which the Bureau is engaged, it is hoped that it will also succeed in reaching people who have not been reached in the past, and that the number of persons taking advantage of the service the Bureau offers will be increased and will continue to grow as time goes on.

Henceforth the results of the work of the mining department will be made available to the public in the following ways:

1. Through the medium of this monthly publication attempt will be made to record current field work of the technical staff, current figures relative to mineral production in California, and 'progress reports' of all Bureau activities which have formerly been summed up and compiled at the end of an annual or biennial period.

2. The second type of work mentioned will comprise a continuation of investigations of special subjects, followed by special reports, as has been done in the past, and which necessarily must mean a rounded out field campaign followed by a detailed technical report, whether it take three months or two years to complete. This character of work is represented by such Bureau bulletins as those on 'Methods of Mine Timbering'; 'California Gold Mill Practice'; 'Mine Drainage'; 'Quicksilver Mining and Metallurgy'; 'Petroleum Resources of California,' and many others.

Work done under No. 1 will be largely along economic rather than technical lines, and will give, as far as practicable, an accounting of all mining activities.

The State Mining Bureau is maintained primarily to assist in the development of our mineral resources. The people of California spend part of their money through the Mining Bureau because they believe it will result in added prosperity to the State. The law under which the Bureau functions does not provide for a research department unless research is deemed necessary to bring out facts of purely economic importance.

It is therefore construed to be as much of a duty of this office to assist a man in finding a market for his product, or a manufacturing concern in locating supplies of raw materials, as it is to offer information or advice, when called upon, as to all phases of the mineral industry.

Returns to the State for the money spent in maintaining the Mining Bureau is received many times over as a result of placing simple facts in the hands of parties who require that particular information.

Many inquirers call on the Bureau for data and consequent results of their efforts are not recorded. Others, however, have kept in touch with the Bureau, and many instances are known where this office served as a starting point in the building up of a business or an industry which subsequently gave employment to large numbers, added to the wealth of the State, and assumed its share of the tax burden that must be borne by all, thereby lessening that burden both by the production of *new* taxable wealth, and by increasing the numbers who bear the total load.

The monthly chapters will be subject to revision, correction and improvement. They will be made up of data furnished by all the technical staff. Suggestions from the mining public will be gladly received and are invited. The motto of the State Mining Bureau is 'Service,' and the object of all its endeavors is to increase the quality and quantity of service offered in order that such service may bring about an increase in actual development of the wonderful latent mineral resources in the State of California.

It is the desire of the State Mining Bureau to have the monthly chapter reach the hands of all interested parties, and those who wish to receive it regularly will have their names placed on the mailing list upon request.

FLETCHER HAMILTON,
State Mineralogist.

DISTRICT REPORTS OF MINING ENGINEERS.

The Seventeenth Report of the State Mineralogist, 1920, was the first to be issued following the organization of the Mining Department into four main geographical divisions, with the field work delegated to a district engineer in each division, working out from a local branch office.

Although handicapped by changes in the personnel of the staff and other unfavorable conditions incident to the establishment of branch offices, the new measures adopted brought the Bureau into closer touch with the industry, and enabled it to present facts and conditions as of sometime during 1920, in the Seventeenth Report, and to have the volume ready for distribution a comparatively short time after the close of the year.

As a further step toward keeping the public advised of current activities affecting the industry, a monthly report prepared by the district engineer of each division will form a regular feature of the contents of the monthly chapter of the State Mineralogist's Report for 1922, thus making each issue an up-to-date compendium of California's mining progress.

The counties included within each field division and the location of the respective local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is clearly distinguished from other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's 'oil fields' will be included under the same heading as the district engineers' reports.

REDDING FIELD DIVISION.

Preliminary Report No. 8, entitled 'Mining in California During 1921,' contains a review of the mining activities in the Redding district, as noted by the district engineer while in the field, up to December 15, and is the latest report available.

Unfortunately plans of the present monthly chapter necessitated a change in the allocation of some members of the staff, and Mr. C. McK. Laizure, former district engineer at Redding, was transferred to the San Francisco office on December 15. It was presumed at the time that a successor would be assigned to the Redding field within two weeks, but it was later found impossible to consummate the change before February 1, 1922.

As a consequence, the Redding office was without an engineer during the period covered by the present monthly report, although the office was kept open for the convenience of the public, and mail and routine matters were taken care of by the stenographer, Miss Ione Russell.

The following notes regarding operations during the past thirty days in the Northern field have come to the attention of the Bureau from various sources, and are here given, although lacking confirmation by a Bureau representative for the reason stated.

John Lorenz of Weaverville, one of the owners of the Lorenz Hydraulic mine, is reported to have leased the Nash mine near the head of Coffee Creek in Secs. 6, 7, 8, 28, 29, 30, 31, T. 37, 38 N., R. 9 W., about fifteen miles west of Carrville. The Nash was formerly operated as a hydraulic mine by the Trinity Hydraulic Gold Mining Company, Ltd., an English company. It is described in detail in the Tenth, Thirteenth and Fourteenth Reports. The Nash was a good producer, but the ground is so nearly level that it was difficult to work by hydraulicking. Lorenz expects to work the gravel with a dredge.

The Shasta Dredging Company, operating a dredge on Cottonwood Creek near Gas Point, has bonded one thousand acres of auriferous gravels including the claims of J. E. McLean in the Minersville district, and will prospect them by drilling.

The Valdor Dredging Company, at present operating below Junction City, has also been prospecting ground in this vicinity.

The American Gold Dredging Company, whose dredge on the Sacramento River opposite Redding has been shut down for a year, will resume operations in January. Three shifts will be put on.

Machinery for constructing a ditch to replace nine miles of flume at Farnsworth Bros. mine on the South Fork of Salmon River is being taken in via the Black Bear road.

Persistent rumors are in circulation that a coal, iron and steel corporation with a capital of $25,000,000 is being organized by Utah and California capitalists and that they purpose to acquire the property and plant of Noble Electric Steel Company at Heroult, Shasta County.

Completion of the wire rope tramway from the Hornet mine of the Mountain Copper Company to Mathewson on the Southern Pacific Railway has been delayed for two weeks on account of bad weather and is it not expected to have it ready before February 1. Shipments of pyritic ore have been increased again to approximately five hundred tons per day. A large warehouse is being constructed at the lower end of the tram. Men employed 125 to 150.

According to press reports, Manager Egleston of the Mammoth plant of the U. S. Smelting, Refining and Mining Company is quoted in regard to the copper situation as saying ''The price of copper has picked up a good deal lately but the advance is not enough to warrant resumption of mining and smelting at Kennett. It is possible that something may be done during the year, but as yet there is no sign. The situation is still unsettled, though hopeful.''

AUBURN FIELD DIVISION.

C. A. Logan, Mining Engineer.

Winter storms that set in late in December put an end to prospecting and new outside work in the mountains. At the same time there has been a good fall of snow which will assure a water supply for placer mining and power purposes for the coming season.

M. J. Calnan is planning considerable work on the Calnan Group of copper claims near Genessee in Plumas County. It is reported that an air compressor and machine drills will be installed and a crosscut will be run from the adit on the Keystone claim to prospect large quartz veins on the other claims.

A. L. Wartman is reported to have produced considerable platinum this fall from placer claims near Pilot Peak in the Onion Valley district in Plumas County.

Possible activity at the Banner claims east of Nevada City is indicated by the transfer of the claims to the Banner Consolidated Mines Company. The same company is supposed to be interested in the Norambagua mine south of Grass Valley.

The Glenn drift mine in eastern Placer County is showing a wider and richer body of gravel as work continues in the lower adit. Clean-ups at a rate equal to $1,000 to $1,200 a week have been reported lately from this adit from gravel taken out in driving upstream and there is said to be considerable good gravel left for future extraction on both sides of the drift. The stock in the owning company has recently paid a small dividend.

The Rising Sun mine near Colfax has been shut down for the time being.

Dan Russell and partners of Colfax have lately been putting up a small mill on a claim between the Forest Hill road and Colfax, just west of the North Fork of American River.

Haines Gridley, superintendent and secretary of the Oro Fina Mining Company, and for seven years past the moving spirit in the operation of that mine, died early in January at his home in Auburn. Mr. Gridley made the Oro Fina mine a paying property by his careful and conscientious work, and during his superintendency it has been the only producer in the Ophir district, and practically the only producing quartz mine in Placer County. Development and prospecting has been kept up for several months past because of Gridley's faith in the property, but the future policy of the company is not yet known.

Columbus mine. According to advice received January 15 from West Point, Calaveras County, the Columbus mine near there is producing sensationally rich ore from a shoot encountered in November last. A crew of eight men and a small Gibson mill are busy.

The Hagerman mine, similar geologically to the Columbus, but lying across the river from it in Amador County, is also said to have a shoot of rich ore three feet wide.

Old Elephant gravel mine. Hydraulic mining began the first of January at the old Elephant Gravel mine near Volcano in Amador County, but was halted in a few days by cold weather which froze up the water supply.

Improvements of existing dirt roads which at present extend from Auburn to Sonora via Placerville, Sutter Creek, Jackson and other towns on the Mother Lode, was contemplated in a bill passed by the last legislature. The resulting road is to be called the Mother Lode Highway. Work began late in 1921 on this road between Auburn and Cool. Early in January a meeting of delegates from the various counties concerned was held in Jackson to further the work. This highway will be of great benefit to all mines along its course. The route is open all winter at present for automobiles, but much can be done to improve its condition and to reduce costs of hauling over it. It will connect at Auburn, Placerville, Jackson and Sonora with state highways and railroads.

A bill of interest to miners was introduced in the Senate this month by Senator King of Utah. It authorizes the Secretary of the Interior to permit prospecting, development and use of any mineral resources found within the boundaries of national parks. If passed, the Secretary of the Interior would have power to establish regulations under which such work might be done.

A State Supreme Court decision that is of some importance to mining interests was recently made in regard to the powers of the late Water Commission, now a part of the Department of Public Works. This decision holds that the above body must approve applications made for appropriating unalienated water supplies, if the applications are in proper form. This seems to settle the question as to what powers the Water Commission had in regard to applications for water from streams where applications were for amounts in excess of all free water in the streams.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

There is little to add at this time to the facts contained in the review of mining in the San Francisco district which was published in Preliminary Report No. 8, and which outlined conditions relative to the mineral industry covering the calendar year 1921. Weather conditions have not been favorable for visiting properties in the hills, and pressure of other duties has kept the writer at his desk since the completion of the annual review mentioned.

A point of rather widespread interest, which has been focused in the San Francisco office, is the matter of reopening of hearings by the Department of the Interior as regards claimants for reimbursement under the amended War Minerals Relief Act. Much of the local engineer's time during recent weeks has been taken up in attempting to assist miners of chrome and manganese in obtaining proper advice relative to procedure required by the federal government. On another page will be found a statement in which are correlated all the facts in the case known to the Bureau.

This has been given out by the State Mineralogist in answer to direct inquiries and is printed here in the hope that, even at the last moment, it may benefit some who have not been able to run to earth any definite facts concerning the publications of official statements urging the production of the 'war minerals.'

During the past thirty days reports from various sources have been received of developments in the mineral industry in various counties of the San Francisco field division. It is planned to review here only such activities as have been personally investigated by the Bureau representative, but in the present instance,where it was not possible to do any field work, the following notes are given until such time as they can be checked up and described authoritatively and in detail.

California Pottery Company is said to have started operations in first unit of their new plant at Merced. Building tile is reported to be the principal product.

Sierra Magnesite Company is reported to be constructing a calcining plant at Porterville which will handle the crude magnesite from the company's mines near the town of Success. In the future it is said that all crushing and calcining operations will be carried on at the new plant instead of at the mine, as was formerly done.

Louise K. Knapp and Fanny H. Beck recently located two placer claims on the beach near the mouth of Tunitas Creek, San Mateo County. Black sands containing small amounts of gold and sometimes a trace of platinum have been noted in the past at various points along the beach from San Francisco to the shores of Santa Cruz County.

Messrs. Van Hook and McMillan are reported to have leased a limestone deposit at Jenkins Hill in the Merced River Canyon above Bagby. It is understood that they plan to establish a distributing plant at Merced and sell crushed limestone for fertilizing purposes.

Sulphur Bank quicksilver mine, near Lower Lake, Lake County, is reported sold to Messrs. Mocine and Martin. This famous property was a large producer in the past.

The Patriquin quicksilver mine, north of Parkfield, Monterey County, is reported sold to Albert Mayhall of San Luis Obispo.

Tin ore is said to have been discovered on the F. B. Bailey ranch above Springville, Tulare County, The authenticity of the report is seriously questioned, but inasmuch as tin has been one of the few metals of which the United States has lacked domestic supplies, it will be interesting to look into this matter carefully at the earliest opportunity.

George Janoko, box 253, R. F. D. 1, Porterville, California, reports the discovery of a coal prospect in Southern Tulare County. He expects to do some development work in the near future.

H. V. Underwood, Sunny Slope road, Hollister, has discovered lignite outcroppings near that town in San Benito County.

LOS ANGELES FIELD DIVISION.

M. A. Newman, Mining Engineer.

The Kelly, Coyote, and other properties at Randsburg continue to draw investors to that region. It is now reported that the Elkins and Flynn Syndicate will sink a shaft 1200 feet deep to open up their holdings, which comprise the Silver Reef and other claims. Canadian capital has interested itself in this property.

It seems impossible for a new camp not to be cursed with mining litigation and the rumored lawsuit between the Kelly and Coyote properties is almost a certainty. Both sides have engaged legal talent and the usual array of mining engineers and geologists have been retained by both factions.

A plant which is being watched with much interest is that of the Refiners Clay Company, at Vernon, Los Angeles. This was designed by a local firm of engineers for the refining of bentonite. It is claimed that bentonite is likely to replace fullers earth as a filtering medium.

It is reported that the mines owned by the Green Campbell Estate after being closed down over 20 years are to be unwatered and opened up by modern methods. These are located in the old Vanderbilt district in San Bernardino County, near the Nevada line.

Mining for oil, instead of drilling, sounds rather startling; yet that is exactly what is to be done four miles south of San Luis Obispo on the R. M. Smith tract. A company organized in the east and under the direction of J. D. Fields is to mine by steam shovel methods the oil sands on this tract. These sands contain oil and asphalt and their extraction is to be accomplished by using K. and K. flotation machines. The success of this venture will be closely watched by oil operators.

OIL AND GAS DEVELOPMENT.

R. E. Collom, State Oil and Gas Supervisor.

In the resume of development and production conditions in the oil business during the year 1921, which appeared in Preliminary Report No. 8, 'Review of Mining in California During 1921,' some estimates were made as to California's production record for the year 1921.

According to data now made available by the statistical department of Standard Oil Company, California produced 114,849,924 barrels of crude oil during 1921. This exceeded the production of 1920 by 9,128,000 barrels.

Oilfield operations reported to the State Oil and Gas Supervisor during the year 1921 show 1287 notices to drill new wells as compared with 893 notices received during 1920. The successful results of prospecting during 1920 were in a great measure responsible for the increased drilling activity of 1921. About one-fourth of the new wells reported were drilled at Huntington Beach, Elk Hills and Long Beach. In addition, about 175 wells were reported from shallow drilling at Devils Den in King and Kern counties and Conejo in Fresno County.

The production of these latter wells has no material bearing however on the State's production as a whole.

It is a reflection however of the general sympathetic reaction and response to the increased demands of petroleum in 1920.

As is generally the case, more drilling has been done and more production obtained than was actually necessary to establish an exact balance between supply and demand. The year 1922 opened therefore with an overproduction of crude and a tendency to curtail drilling and producing operations in San Joaquin Valley fields and to concentrate upon the more desirable production of new areas such as the Santa Fe Springs oil field.

One of the most noticeable features of oilfield operations in 1921 is revealed by the records of redrilling work. In 1921 671 notices were filed to redrill or deepen, as compared to 878 notices for 1920. This indicates that operators were giving more attention to the development of new fields in 1921 and less to the repair and upkeep of the older wells. In times of flush production and successful wild-catting the tendency is to neglect the older producing wells.

SPECIAL ARTICLES.

As heretofore, detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins.

Shorter and less elaborate technical papers and articles by members of the staff, possibly augmented by contributions from sources outside the Bureau, not of sufficient length to be issued separately, but containing much information that will add to the permanent value of the monthly chapter, will be included in each number.

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations; as well as articles intended to supply practical and timely information on the problems of the prospector and miner.

Press bulletins and mimeographed letters giving the text of new laws and other official regulations and notices, affecting the mineral industry, have formerly been used to disseminate information of the latter character.

PLACER GOLD RESOURCES.

By Chas. S. Haley.

Investors outside the State of California, no less than residents of the State, have little conception of the possibilities still dormant in the tremendous bodies of tertiary and quaternary gravels which are as yet unworked in its borders. Conservative estimates of the amount of gold which can still be obtained vary from one to three billions of dollars. In view of the fact that the State's total production of gold since 1848, from both quartz and placer mining operations, is about one and one-half billions, these figures are very significant as indicative of the potentialities of the situation.

The Sawyer decision, in 1884, wiped out at one blow the value of upwards of $100,000,000 in investments in hydraulic mining operations in this State. The Caminetti Act, designed originally to relieve the situation, has failed to do so.

An investigation is now being undertaken by the Bureau with the object of determining the available placer resources of California and of indicating the best and most feasible means of working them. A plan is being worked out which will be not only of benefit to the mining industry, but, so far from being detrimental to the agricultural interests of the community, will be of positive and definite benefit to them.

In order to take advantage to the fullest extent of the present revival of interest in gold mining, it is extremely desirable that this report shall be available by the spring of 1923.

Owing to the limited funds at the disposal of the Bureau for the work, it is possible to retain only one investigator in the field, who must cover the entire State by the end of 1922. For this reason, the utmost cooperation is desired from the citizens of the mining counties of the State, and from all who are interested, directly or indirectly, in the revival of the industry.

This bulletin is designed to be of assistance not only to the large investor and capitalist who wishes to know the most likely fields for careful investigation; but also to be of interest to the smaller investors and the prospectors who are seeking places for the man of limited means not only to make a living, but to secure a return on what capital he may have at his disposal. This in itself will be of great direct benefit to the quartz mining industry by increasing the number of prospectors.

Despite popular opinion to the contrary, there are still many localities in this State where the '49ers did not gather all the money. And for the larger investor, under a feasible scheme of adjustment to the needs of the agricultural industry, there are possibilities of reasonably safe and sound investment with a speculative chance of exceedingly high returns.

Already in covering the Feather River, Klamath River and Northern Sacramento River areas several large deposits of virgin gravel have been encountered of which little or no information has ever been published, and on which scarcely any prospecting has been done.

The report will be devoted more to the economic side of the gravels than to the geological one, although the work of more able geologists than the present investigator will be freely drawn upon wherever it has a direct bearing upon the profitable operation of the gravels.

It is hoped that the cooperation of the mining public will be given in order that the report may be published in time to be of the greatest assistance and use to the proper development of the resources of the commonwealth of the State of California.

NON-METALLIC MINERALS OF SOUTHERN CALIFORNIA.

By M. A. Newman.

INTRODUCTION.

This is the first article of a series dealing with the mineral resources of Southern California, giving particular attention to the non-metallic wealth of the vast desert region, which lies partly in the southern section of the State. Its aim is to simply touch on the salient controlling factors regarding the exploitation of the immense resources in these desert regions. The other articles will treat in detail such important members of this non-metallic group as borax, kaolin, diatomaceous earth, gypsum, graphite, marble, potash, soda, and others for which there is an increasing demand.

There is probably no equal area on the face of the globe which is as rich in natural resources as California. It possesses within its borders nearly every element necessary to our modern civilization and if the State were suddenly isolated from the rest of the universe, it could maintain itself from the resources within its borders and on a standard equal to our present enlightened period.

Brought to the attention of the world by Marshall's discovery of gold, its production of this precious metal from 1848 to the end of 1920 has amounted to the immense sum of $1,679,022,820. Its glorious gold epoch has now been eclipsed by another mineral, petroleum, which at present is on the ascendant, and will in a few years surpass our gold yield.

Petroleum may not be classed as a 'noble' mineral, yet production in California from 1875 to the end of 1920 yielded its producers $1,004,839,489. Of this immense sum 80 per cent has come from Southern California.

If Southern California possesses a vast undeveloped wealth in its non-metallic resources, what are the necessary conditions for their profitable exploitation? The answer to this, I believe, lies in transportation facilities and the marketing of the non-metallic products.

The population of California in general, and Southern California in particular, is growing by leaps and bounds. There is nothing visible on the horizon that suggests any decrease. In fact, everything indicates that the growth in the next ten years will surpass by several times the increase between 1910 and 1920.

The advent of the automobile has resulted in the building of a magnificent system of highways all over the State. These highways are tied by laterals which reach into the mountainous regions and traverse our deserts. As a result, deposits which were inaccessible a few years ago by railways can now be reached by auto trucks. The harbor which the South possesses at San Pedro will enable our non-metallic products, through cheap water transportation, not only to enter into competition for business in the densely populated regions of the eastern seaboard of the United States, but also for the markets of Mexico, South America and the Orient.

Due to the tremendous development of hydro-electric power a great surplus will soon become available and a cheap power rate will result.

There is also another source of power now going to waste to a great extent. I refer to natural gas which is not being utilized to its fullest extent. No more ideal fuel can be obtained for the ceramic industries than natural gas. Capital is beginning to grasp the possibilities, and with an increasing demand for the products of our non-metallics, it will find a field for its investment.

There is nothing that can now stop the gradual development of our non-metallic deposits, because

1. Modern transportation facilities have made them accessible.
2. The rapid growth of population has created sufficient local market for manufactured products of our non-metallics.
3. The establishment of direct steamship lines from Los Angeles Harbor to South America and the Orient, as well as our eastern seaboard, will allow the direct exportation of any surplus product manufactured.

NOTES ON THE WEST POINT DISTRICT, CALAVERAS COUNTY.

By C. A. Logan.

Foreword.

The following pages contain some of the writer's notes on properties visited. Previous published and unpublished reports of a fragmentary nature have also been drawn upon when considered to be reliable. Not all of the properties mentioned have been examined by the writer, as circumstances have not permitted nor has the relative importance of the district seemed to call for a full report. At the same time it is hoped these notes will serve to give an inquirer a better general idea of the district than can be had from a perusal of the different short reports previously printed.

Geography.

The mines of this district surround the town of West Point, which lies near the north boundary of the county at an elevation of 2800 feet, on a plateau between the North and Middle Forks of Mokelumne River. West Point is 19 miles by road from the terminus of the Amador Central Railroad at Martel, and 28 miles from the Southern Pacific at Valley Spring. The road from Martel to West Point is preferable, though quite steep where it enters and leaves the river canyon. The climate is fine with little snow in winter, and natural advantages for mining are good. The steep canyon sides of the river's three forks have made good tunnel sites available and there is a good supply of timber and water.

Geology.

Most of the mines of the district lie in the area of granodiorite which has a width of nearly five miles from north to south and extends west nearly five miles from the town in the form of a peninsula from the main mass of the Sierras. The granodiorite penetrated the older metamorphic rocks which were for the most part originally sedimentary, but have been folded and tilted and altered to black micaceous schists, hard slate and quartzite. These rocks generally strike a little west of north and dip steeply east. Little study has been made of them, but they are supposed to be of Carboniferous age. The eastern portion of the granodiorite is partly covered by andesite flows. The granodiorite shows local variations especially along its borders and has been variously termed quartz-mica diorite, hornblende granite, and diorite. Dikes of dark colored intrusives, usually diabase or similar rocks, occur in the schists at times parallel to the veins. Two systems of greenish diorite dikes are noticed in the granodiorite. The system striking north has been considered important in connection with ore occurrence in some of the mines. Jointing is common in the granodiorite probably as an effect of weathering, and distinct from the ore bearing fissures. Sometimes these joints are occupied by small quartz bodies, and are misleading to the miner, who in following a fissure may easily get off on the wrong track.

History of mining development.

West Point has been known as a pocket mining camp since the early fifties, and the art had reached a high stage of precision there fifty years ago. In those days, the local miners' regulations limited the length of a claim to 200 feet. The veins are numerous and easily traced. They have been worked in many cases to only about 150 feet in depth by shallow shafts and adits, though a few of the larger producers have been opened much deeper. Ore that paid less than $20 a ton in the early days was classed as low grade and scarcely worth bothering with, except in the rare case where the mine was equipped with a mill. Ore not rich enough to mortar was crushed in small custom mills and arrastras at a cost of from $5 to $7 a ton. Usually no attention was paid to the sulphides.

In 1867 there were eleven small mills, mostly doing custom work, running in the district. The custom mills drew their ores from the properties being worked by pocket miners, of whom there were about 100 working there at the time. The Skull Flat Company was running ten stamps and was mining ore said to have been worth $30 to $35 a ton. A roasting furnace was in operation at Morris' mill, treating ore worth $50 a ton. The Woodhouse mine, between the Middle and South forks of Mokelumne River and four miles from West Point, had a 15-stamp mill and up to the end of 1867 had produced 14,000 tons of ore that yielded $140,000 in free gold. The owners recognized that they were losing much of the gold in the sulphides and had contracted for a roasting furnace to handle concentrate. The Holmes mine, just south of the Woodhouse, was opened and equipped with a 10-stamp mill in 1866 and was producing. The sulphides were said to be worth $300 to $1,300 a ton. The 15-stamp mill at the Mosquito mine, five miles west of West Point, was idle at the time, pending the opening of the vein at depth through a new adit. Eighteen stamps at the Vance and Mina Rice were idle, and four small mills and several arrastras were working entirely on custom ores.

But the progress since then has not been such as might reasonably have been expected. A few mines were worked during the next 25 years, but none very extensively. The Lockwood mine, three miles southeast of West Point, was opened to a depth of 430 feet. Concentrate was saved and treated in a chlorination plant that did custom work for $20 a ton. The Blazing Star mine, a mile and a half east of West Point, was worked from 1877 to 1895 to a depth of 400 feet. The Lone Star and Reed and Hillary parallel veins in the canyon of the North Fork of the river, four miles west of the town, were worked in a small way from 1854 to 1890, and then on a larger scale than any other mine in the district up to 1905. The Champion mine paid well to a depth of 740 feet. In the past 16 years little has been heard from the district, but since 1919 there has been some improvement and there is promise of greater interest and activity next spring.

Character of the ore deposits.

The veins are of the fissure type and with a few exceptions noted later, are all found in the granodiorite. A notable feature is their persistence on the strike, especially when the narrowness of most of them is considered. The Woodhouse vein, covered by the mine of the same name for a distance of 4500 feet, contained two ore shoots 150 and 400 feet long, respectively, in a distance of 3000 feet, then split up into branches carrying pay for 1000 feet farther. It is said to be traceable over two and a half miles. The Sawyer vein, ranging in width from eight inches to five feet, is said to be easily traceable for a mile. The Lone Star and Reed and Hillary and other long veins could be cited. There is a marked uniformity in the strike and dip of the veins. The strike is usually north to north 25 degrees west and the dip commonly west or southwest from 45 degrees to 80 degrees, being as a rule steep. Narrow dikes are common, but as far as can be learned from the history of past operations and from observation, these have had little effect in faulting the veins and usually none in influencing the location of pay shoots. Most of them are probably so small that they could not in any case have exerted any important chemical or physical effect on the firm rock into which they were injected. Those that cross the prevailing strike of the vein system have been considered younger than the veins, but there is a group of dikes that run parallel to the veins and may be about the same age as the veins. Series of diorite dikes cut across the vein in the Lockwood mine. The Sawyer vein is followed by a parallel dike for 140 feet. In the old workings of the Carlton mine a series of younger dikes cut the vein, without, it is said, having had any effect on the ore, which was found on both sides of them. In the Black Wonder mine a dike was observed in the shaft parallel to the vein, and the ore from this shaft was heavily charged with sulphides and of very good grade. The Champion ore body was in a dike, and here, contrary to the rule, a dike cut off the ore body in depth.

In most of the mines there is little evidence of post-mineral faulting or mineralization of the walls adjacent to the veins. The Lone Star vein, probably the widest seen, has been described as a replacement of the granite, crushed between a series of fault planes. It has a maximum width of 17 feet near the shaft and carries there a good gouge. Many of the smaller veins are quite tight with little gouge, or even frozen to the walls, with the hard granodiorite close up to them.

The ore makes in shoots 25 feet to 400 feet long and is composed of solid quartz with a minor amount of mineralized granodiorite. Below the zone of surface oxidation the valuable quartz is typically greasy looking and bluish in color. The operations of the pioneer miners were confined for the most part to the oxidized upper portions of the veins where the gold was free. Ore rich in sulphides is found at about 130 feet in depth. Pyrite, pyrrhotite, galena, zincblende, marcasite, arsenopyrite, and chalcopyrite have been reported. The iron sulphides are by far most plentiful, and arsenic, zinc and copper are subordinate and not always noted. The presence of galena is held to be especially favorable. The percentage of sulphides goes as high as 20 per cent and in some cases exceeds that. They range from $50 to several hundreds of dollars a ton in value, and much pay was wasted in the early days by not saving them.

Details on some of the mines.

Black Wonder mine. This is in the Calaveras series of hard slates and schists, southeast of West Point. It was last worked from 1918 to late in 1920. There is a shaft 130 feet deep on the vein, which there shows a width of five feet; 1360 feet south of the shaft the vein is two feet wide. In 1919, a lower adit, designed to give a depth of 210 feet on the vein at the shaft, was in 800 feet and was 500 feet south of the shaft. It was later driven about 100 feet farther. A carload of sorted ore shipped from the shaft in 1919 was reported to carry 42 per cent iron sulphides, 9 per cent galena and 2 per cent zincblende, with no copper or antimony. It returned 3 ounces gold and 17 ounces silver a ton. A Gibson mill was put up in 1920 and a few tons of ore were crushed from a shoot 30 feet long which was encountered in driving the lower adit. The mine has been closed since August, 1920.

Blazing Star mine was a producer of high grade ore at intervals for 20 years following 1875. It has a shaft 400 feet deep and levels at 210, 260 and 360 feet which were run about 500 feet to work an ore shoot 450 feet long. In 1893, 210 tons of ore shipped for smelting returned $15,546 gross. In 1894, 143 tons shipped gave a gross yield of $11,056. Ore milled at the mine during these two years is said to have yielded $21.50 to $28 a ton. Some experiments in cyaniding the concentrates were made in 1895, but little has been done since.

Carlton mine is opened in the present workings to a depth of 130 feet by two adits 352 feet and 250 feet long, 86 feet apart and connected by a raise in the vein. An old shaft worked years ago was 160 feet deep. There is also an old shaft 40 feet deep. For a length of 50 feet adjacent to the raise the vein has been stoped part way up between striking northwest and dipping southwest 70 degrees. This ore shoot yielded 12 tons of ore worth $110 a ton. The mine is active at present.

Champion mine. The ore body in this mine lays in a diorite dike the adits. It has a maximum width of two and one-half feet and is said to horn $20 to $30 a ton free gold. The 40-foot shaft is said to have was 90 feet long and was bounded on both ends by parallel fissures striking northeast. The ore was stoped the entire distance between these fissures to a depth of 700 feet. Near the west end of the shoot on the 700 level a winze was sunk 40 feet and is reported to have yielded $10,000. In the bottom of this winze the ore is said to be cut off by a dike. The main ore shoot was a lens-shaped quartz body 10 inches to four feet wide. The shaft was continued to 900 feet and on the 900 level about 300 feet of drifting and crosscutting was done without definite results. On the 400 level a drift 100 feet long was run and 100 tons stoped from the west parallel fissure. This is said to have been six to 16 inches wide and heavily mineralized with galena. According to an old report, it was also rich in free gold. This was the only work done on the parallel veins.

The Champion is thought to have yielded about $500,000. This was all in free gold, and the loss in the sulphides must have been great. The quartz was crushed in arrastras, and it is said that nothing worth less than $60 a ton was crushed, but this is probably an exaggeration. The mine has been idle since 1881.

Columbus mine adjoins the Lone Star on the south. It is being operated by W. W. Gibson, and a little ore is being crushed in a Gibson mill. A shoot of ore had been followed sixty feet when the mine was visited in November last, and was still showing in the face of the drift, which is 130 feet below the outcrop. The vein is four and one-half to five feet wide in this shoot. It strikes north and varies in dip from 70 west to 70 east. At a point 300 feet south of the present face, and 50 feet higher, the vein is six feet wide and is said to assay $8 a ton. Two hundred feet north of the face the vein is said to have been 10 inches wide and to have yielded at the rate of $100 a ton from the Mackenzie shaft, 80 feet deep. In the Moore shaft, 40 feet deep and 200 feet north of Mackenzie shaft, it was of similar width and specimen grade. The quartz in the present shoot is bluish and greasy looking, and is said to carry an average of 6 per cent sulphides, but some bunches of ore were seen which would probably run 20 per cent to 25 per cent sulphides. Pyrrhotite is predominant and copper is present. These sulphides are reported to run up to as much as $500 a ton gold and silver at times.

Keltz mine is being prospected by North Star Mines Company of Grass Valley. There are nine claims in the group, covering a series of veins, but most of the work has been done on the Keltz and Keltz Extension claims. The Owl, Hard Lead, Englishman's and Middle veins have been worked superficially by shallow shafts and short adits. The steep slope of the North Fork canyon allows adit mining. The new adit is 625 feet below the old upper workings and about 100 feet above the river.

In the old upper workings, now mostly caved, the vein is in granodiorite and is paralleled by a fine grained dike. The new adit is a crosscut east 450 feet, with drifts 300 feet south and 145 feet north at time of visit. Short crosscuts were run from each drift. From the north drift just past the fork, a raise was up 141 feet. All this drifting and raising is in hard greenish black fine grained dike rock. This is sprinkled with the sulphides, especially with pyrite and pyrrhotite. In the drifts small bunches and stringers of quartz were observed, frozen tightly to the walls. These are said to be rich at times. One of these was followed 70 feet and had a maximum width of one foot but was cut off by a transverse slip. Some bunches and stringers, the largest eight inches wide and well filled with yellow and brownish sulphides, have been found in the raise. These show no grooving and only one-half inch of gouge in places. The top of the raise was then 110 feet below the deepest old workings. No important amount of ore had been found yet by the present company, and it would appear that the most likely place for the occurrence of a vein is considerably farther ahead.

Lockwood mine was worked off and on from 1850 to 1914 and was quite fully described in a State Mining Bureau report published in 1915, to which reference is made. The vein was opened to 430 feet depth. From the 230 level to the surface and for a length of 500 feet, it was credited with a yield of $400,000. Ore ranged from $12 to $150 a ton in value. The mine has been idle for a number of years.

Lone Star mine is being prospected by North Star Mines Company of Grass Valley. It was worked from 1854 to 1905 at intervals and then closed until 1920. A series of adits called No. 1 to No. 5 were driven from the canyon side. No. 4 is 358 feet below the outcrop and 2500 feet long, and No. 5 is 468 feet below the outcrop and 1500 feet long. A shaft was sunk 300 feet below No. 5 (which is near the river level) and 'minus 200 level' was driven north 181 feet and south 360 feet. This is 185 feet below the river. The Lone Star vein shows a maximum width of 17 feet and a series of ore shoots 100 to 320 feet long and two feet to six feet in average width were worked in a distance of 1200 feet. The parallel Reed and Hillary vein about 90 feet west was worked also nearly to the river level by a series of adits and showed some long ore shoots. These larger veins naturally show more mineralization of the wall rocks than the smaller veins of the district. They carry considerable gouge in places.

The present company has re-equipped the mine and had done about 500 feet of new work on the 'minus 200 level' on the Lone Star lead to the time of visit. On the south they crosscut 65 feet west and had followed a vein 240 feet, south 8 degrees west. This had opened up to about three feet wide. The north face showed a stringer of sulphide ore two inches wide which had been followed 50 feet and was said to be high grade. The south face of the old No. 5 tunnel and also of the 'minus 200 level' as left by the former operators had not been in ore and J. B. Stapler, superintendent, expressed the opinion that the former company had gotten off the vein into another fissure. He believes the vein picked up in the crosscut is the Lone Star vein. Observations made on No. 5 level showed that it would be easy to make such a mistake if no crosscuts are run.

Sixteen miles of ditch supply a minimum of about 200 inches of water to furnish power for the hoist and compressor. A crew of 30 to 35 men are employed. Machine men are paid $4.50 and muckers $4 a shift.

The following table shows in outline some of the details regarding the numerous small mines and prospects in the district. It is not put forth as complete; there are mines that are omitted because of lack of details, and among this number are no doubt some that have never made any production. There are also cases where shafts have been deepened and drifts run since the information was gathered; but the table will probably serve the purpose intended, namely to emphasize the large number of veins that have been worked with some measure of success to uniformly shallow depths, and to point out the features of similarity shared by them.

TABULATED DATA ON SOME WEST POINT MINES.

Name of mine	Location (from West Point)	Width of vein		Depth reached in		Length drifted on vein	Length of ore shoot	Dip in degrees	Strike in degrees
		Maximum	Average	Shaft	Adit				
Alaska	2 miles E.	2 ft.	18 in.	90 ft.		175 ft.		75 W.	N. 15 W.
Black Wonder	9.2 miles E.	5 ft.	2 ft.	130 ft.		800 ft.	30 and 150 ft.	70 W.	N. 18 E.
Billy Williams	3 miles NE.	2 ft.	1 ft.		350 ft.	200 ft.	75 ft. by 8 in.	65 W.	N. 10 W.
Blazing Star	1½ miles E.	7 ft.	3 ft.	400 ft.		500 ft.	450 by 2 ft.	80 SW.	N. 30 W.
Buena Vista	3 miles W.	2 ft.	1½ ft.		200 ft.	Unknown	Unknown	50 W.	N. 16 W.
Carlton	1.8 miles W.	2½ ft.		160 ft.	130 ft.		50 by 2½ ft.	37 W.	North
Champion	1½ miles W.	4 ft.	10 in.	900 ft.		90 ft.	90 ft.	70 SW.	NW.
Columbus	3 miles W.	5 ft.	2 ft.		150 ft.	60 ft.	60 ft.	70 W.	North
Corn Meal	4 miles S.	2 ft.	1 ft.		150 ft.	200 ft.	50 by 1 ft.	80 NE.	(2 veins)
Deerfoot	1½ miles N.	3 ft.	1 ft.	166 ft.		150 ft.	50 by 1 ft.	70 NE.	N. 30 W.
Eureka	1½ miles NE.	3 ft.	1½ ft.	135 ft.		Unknown		80 E.	N. 15 W.
Excelsior	3 miles SE.	2 ft.			250 ft.	128 ft.	100 ft.	75 W.	N. 10 W.
Ferguson	3 miles E.	2 ft.	1 ft.	127 ft.		Unknown		75 W.	North
Gilbertson	4 miles NE.	2 ft.	1 ft.	105 ft.		70 ft.	50 ft.	65 W.	North
Good Hope et al.	4½ miles SE.	3 ft.				340 and 120 ft.	Unknown	65 E.	North (3 veins)
Gold-Galena	2 miles NE.	2 ft.	8 in.	300 ft.		300 ft.	25 ft. by 8 in.	80 W.	N. 16 W.
Gray	4 miles NE.	3 ft.	1½ ft.	200 ft.	150 ft.	100 ft.	50 and 80 ft.	80 W.	N. 10 W.
Hidden Cave	3½ miles SE.	4 ft.	1½ ft.	100 ft.		126 ft.	100 by 1½ ft.	75 W.	N. 10 W.
Keltz	4.1 miles NE.	4 ft.	1½ ft.	80 ft.	200 ft.	200 ft.	50 and 100 ft.	75 W.	N. 5 W.
Lockwood	3 miles SE.	14 ft.	2 ft.	430 ft.		491 ft.	50 to 200 ft.	80 SW.	N. 23 W.
Lone Point	6 miles SE.		6 in.		40 ft.	225 ft.	25 ft.	50 E.	North
Lone Star et al.	4 miles NW.	17 ft.	2 ft.	778 ft.	468 ft.	2500 ft.; 800 ft.	100 to 320 ft.	75 SW.	NW.
Marino	3 miles E.	2 ft.	1 ft.	112 ft.		50 ft.	Unknown	75 W.	N. 30 W.
Mexican	1½ miles SE.	2 ft.	1 ft.	100 ft.		50 ft.	50 by 1 ft.	75 W.	North
Mina Rica	3 miles SE.	2 ft.	1 ft.	240 ft.		Unknown (3 shafts)		80 W.	N. 20 W.
Monte Cristo	6 miles N.	2 ft.	1 ft.		150 ft.	150 ft.		80 W.	North (4 veins)
Nelson	2 miles S.	3 ft.	1 ft.	101 ft.		300 ft.	100 ft.	80 S.	N. 70 E.
Nixon	1 mile NE.	3 ft.	10 in.	115 ft.		200 ft.	100 ft.	80 W.	N. 30 W.
North Star	2½ miles NE.	2 ft.	1 ft.	340 ft.		200 ft.	50 by 1 ft.	80 W.	North
Novello	2 miles SE.	2 ft.	1 ft.	112 ft.		Unknown		75 W.	North
Price	5 miles E.	2 ft.	1 ft.	116 ft.		60 ft.	Unknown	85 W.	N. 23 W.
Riverside	4½ miles NW.	3 ft.	1½ ft.		200 ft.	400 ft.	50 ft.	70 W.	North
Sawyer	2.2 miles NW.	5 ft.	2 ft.		300 ft.	Indian 120 ft.	140 ft.	90	NE.
Sawyer					125 ft.	Sledge 275 ft.	(Sledgeham)		
Scorpion	1 mile S.	3 ft.	1 ft.	275 ft.		172 ft.	172 by 1 ft.	80 E.	N. 5 W.
Soap Root	1 mile S.	2 ft.	1 ft.	185 ft.		50 ft.	Unknown	80 W.	N. 10 W.
Spring Gulch	2½ miles NE.	2 ft.	1 ft.	90 ft.		50 ft.	20 ft.	75 W.	N. 15 W.
Standard	6.2 miles SE.		2 ft.		150 ft.	100 ft.	Unknown	65 NE.	N. 20 W.
Star of the West	3 miles NE.	4 ft.	1½ ft.	275 ft.		130 ft.	50 by 1½ ft.	80 W.	N. 15 W.
Steger	3 miles W.	2 ft.	1½ ft.	150 ft. 130 ft.	(Adeline) (Steger)	450 ft.	Unknown	65 W.	N. 12 W.
Water Lily	1½ miles E.	2 ft.	1 ft.	230 ft.		200 ft.	200 by 1½ ft.	80 W.	N. 15 W.
(Matrimony)	1½ miles E.	4 ft.	1½ ft.	125 ft.		400 ft.		80 W.	N. 15 W.
Wide West	2 miles NE.	2 ft.	1 ft.	150 ft.		100 ft.	100 ft.	75 W.	N. 26½ W.
Woodhouse	4 miles SW.	13 ft.	2 ft.	175 ft.	400 ft.	450 ft.	150 to 400 ft.	60 W.	North

MINING LOCATION ON STOCK-RAISING LANDS.

(Numerous inquiries have been received by the State Mining Bureau regarding the rights of a mining claim locator on land taken up under the Act of Congress, entitled "An act to provide for stock-raising homesteads, and for other purposes," commonly called the 640-acre homestead act; where such holdings conflict with mining claims or include mineral-bearing land.

At the request of the State Mineralogist, the following statement setting forth the rights of a mining locator on such lands was prepared by the United States Bureau of Mines, and may be taken as official.)

"RIGHTS OF LOCATOR.

"The rights of a locator of a mining claim on grazing or stock-raising lands, is governed by section 9 of the act of Congress approved December 29, 1916, entitled 'An act to provide for stock-raising homesteads, and for other purposes.' (39 U. S. Stats., 862.)

"The entries and patents issued under the act must contain a reservation to the United States of all coal and other minerals in any such lands, 'together with the right to prospect for, mine, and remove the same.' Any coal or other mineral deposits in any such lands are subject to disposal by the United States according to the coal and mineral land laws in force at the time of any such disposal. All qualified persons are expressly given the right at all times to go upon any such lands entered or patented, for the purpose of prospecting for coal or other mineral therein. Any such prospector, however, is not to injure, damage or destroy any permanent improvements of any such entryman or patentee, and he is required to compensate the entryman or patentee for any damage on such lands.

"A prospector who has thus discovered coal or minerals in or upon any lands that have been entered or patented as grazing or stock-raising lands under the provisions of the act, may, upon acquiring from the United States, the coal or other mineral deposits in such lands, and the right to mine and remove the same, then reenter and occupy so much of the surface of such land as may be reasonably incident to the mining and removal of the coal or other minerals, but upon the following conditions:

"1. Before reentering for mining and removing the minerals, he must secure the written consent or waiver of the homestead entryman or patentee, and

"2. He must pay damages to crops or tangible improvements if and when an agreement is reached as to the amount of such damages.

"In lieu of either of the provisions numbered 1 or 2, he may execute a bond or undertaking to the United States for the use and benefit of the entryman, patentee or owner of the land, to secure the payment of all damages to crops or tangible improvements of the entryman or owner, as such damages may be determined and fixed in an action brought upon the bond or undertaking in any proper court. The bond or undertaking must be in form and in accordance with rules and regulations prescribed by the Secretary of the Interior and is to be approved by and filed with the register and receiver of the land office in the district wherein the land is situated.

"Any patents issued for coal or other mineral deposits under the provisions of the act, must contain notations declaring them to be subject to the provisions of the act with reference to the disposition, occupancy and use of the land as permitted to an entryman or patentee.

''Under the first section of the act no land can be entered as a stock-raising homestead until the lands shall have been designated by the Secretary of the Interior 'as stock-raising lands.' After the lands have been so designated by the Secretary, then qualified persons may enter and hold the same for the purposes contemplated by the act and may hold and possess the same for such purposes as against all persons except mining prospectors and those who have acquired the right to mine and remove minerals discovered, as provided in section 9.

''An entryman, patentee or owner of any such lands may, without doubt, make a valid mining location upon the lands, the same as any other person, but in making his mining location, he must comply with the law in manner and form as if he were a stranger.

''The entryman, patentee or owner of lands acquired under this act for grazing or stock-raising purposes, has no preference right whatever to locate a mining claim upon the land. In this respect he is on an equality with all other persons and can take no advantage whatever of the fact that he is the owner or in the possession of the land.

''The rights of all persons making mining locations upon any such land used for grazing or stock-raising purposes, must be measured and determined by the rules of priority that govern in relation to the location of mining claims upon public lands generally.

''Such grazing or stock-raising lands, held under the act, are, for the purposes of making mining locations, in effect, public lands.

''The fact that the notice of a mining location was posted in the night time could not affect its validity, if the locator otherwise complied with the law.

''The owner or occupant of any such grazing or stock-raising lands who defaces or destroys a notice posted upon such lands of a mining location, is subject to the same penalty and punishment as a person who destroys any notice of a mining location.''

STATEMENT TO WAR MINERALS RELIEF CLAIMANTS.

By Fletcher Hamilton.

Since Congress amended the War Minerals Relief Act, this Bureau has been in receipt of so many inquiries that it is practically impossible to give each one my personal attention. I have therefore attempted to correlate such information as I have on hand in the following paragraphs in the hope that they will meet the requirements of all parties interested, even though it may not serve as a direct reply to each particular inquiry received.

Instructions from Secretary of the Interior.

The Secretary of the Interior, in a notice to war minerals relief claimants, announces that motions for rehearing on claims heretofore passed on or excluded must be submitted in writing to the War Minerals Relief Commission not later than February 15, 1922, plainly designating the claim and specifically stating the grounds upon which rehearing is asked. If the claim or part thereof, for which rehearing is asked has heretofore been rejected on the ground that there was no government request or demand, the written motion must be under oath setting forth:

(1) The exact character of the "personal, written or published request, demand, solicitation or appeal" which stimulated the claimant to produce or prepare to produce the mineral.
(2) The government agency mentioned in the act from which the request, demand, solicitation, or appeal came.
(3) How or by whom the request, demand, solicitation, or appeal was communicated to the claimant.
(4) The time and place of such communication.

The claimant is now called upon to show definitely where he got the word that it was his patriotic duty to produce 'war minerals.' In other words, he presumably will be required to give the name and date of the publication in which he read the statement to that effect emanating from a government official source, such as any of the bureaus of the Interior Department or the War Trades Board, etc.

I am in receipt of various requests asking for 'the text of the official announcement encouraging production of the war minerals' and 'the text of the Government's promise guaranteeing prices thereof.'

As a matter of fact, there was no particular 'official announcement' and no price guarantee. The shortage of and need for the various war minerals was something that had a gradual growth and began to be realized in some quarters long before there appeared to be any possibility that the United States would be drawn into the conflict. After we entered the war and along in 1918 when the speeding-up program was being put into effect all along the line, press bulletins and statements of various kinds relative to the production of war minerals were given out to newspapers and spread broadcast by various agencies, but by that time the general situation was so well understood that there is no real beginning or 'introductory announcement' which would be exactly what claimants under the War Minerals Relief Act are looking for, and which many think existed.

This office had no more idea of the importance of keeping a record of the published statements that were given out by the Federal Government than any of the claimants who are now seeking relief, and at the present time I am able to offer only the following suggestions, which it is hoped will be of some assistance to those who are forced to make a search for the evidence they require.

Government representatives who had to do with speeding up of war mineral output.

Before proceeding further, it may be helpful to list the following men who were representing the government in the height of the War Minerals Campaign, any of whom would undoubtedly be glad to offer assistance if called upon:

Mr. Albert Burch, Crocker Building, San Francisco, who was Pacific Coast Chromite Representative of United States Bureau of Mines;

Prof. George D. Louderback, University of California, Berkeley, who was Pacific Coast Manganese Representative of the United States Bureau of Mines;

Mr. J. E. Spurr, Editor of the Engineering and Mining Journal, New York, who was at that time in charge of the War Minerals Investigation for the United States Bureau of Mines;

Dr. George Otis Smith, Director of the United States Geological Survey, Washington, D. C.

Dr. H. Foster Bain, Director of the United States Bureau of Mines, Washington, D. C.

One thing which appeared in many of the newspapers on the Pacific Coast, which not only stimulated chrome production, but which led many to believe that there was a price guarantee, was the advertisement of the California Chrome Company, published under the headlines "Your Country Needs Chrome Ore," and containing the statement that the California Chrome Company was the direct purchasing representative of the Ferro Chrome Manufacturers which supplied the entire requirements of all the steel companies manufacturing armor plate, shells, gun forgings, aeroplane motors, trucks, and other war necessities for the United States government. The Company stated further that they would contract for the balance of 1918 for chrome ore at a minimum of $1.25 per unit for 38 per cent chrome oxide and upward and concluded by stating emphatically that every ton of chrome ore the Pacific Coast could furnish would help to release ships for carrying supplies to our fighters in France.

Published statements emanating from official sources.

Among the publications to which mineral producers responded, I have a record of the following:

1. United States Geological Survey Press Bulletin, January 17, 1918, entitled ''Chromite on the Firing Line.'' One of the most significant statements is: ''At present we are facing a deficit in the supply of chromite and we should spare no effort to increase the supply of this country as well as that of adjacent countries.''

2. United States Geological Survey Press Bulletin, June 20, 1918, entitled ''Speeding up the Production of Chromite,'' as follows: ''With patriotism as well as economic considerations loudly calling for an increase in the output of chrome ore, the miners on the Pacific Coast should do their utmost to speed up its production.''

3. Report of the National Research Council, Department of Science and Research, Council of National Defense, May 24, 25, 1918: ''Need regarded as extremely acute, all material in sight at present has practically been requisitioned for the manufacture of chrome steel and practically none will be available for the manufacture of refractory brick, paint, chemicals, and for use in tanning. The discovery of new deposits is therefore imperative.''

4. Committee on Mineral Imports and Exports, United States Shipping Board, May 4, 1918. This statement explains at some length the ship shortage and the necessity for production of local ores including manganese, chromite, pyrites, and graphite, so that it will not be necessary to depend on imports. It goes on to say that the use of local ores will probably require changes in practice, but these changes must be accomplished regardless of cost or difficulties and that Government cooperation will be necessary. One significant paragraph follows: ''If private interests wait until every detail is settled before taking steps to meet the situation, there is danger of vital damage to essential war industries. Patriotism requires that the mining and metal industries do everything reasonable to get projects started at once.''

5. Bulletin on Chromite, edited by Albert Burch (mentioned above). This publication discusses in detail the necessity of increased production within the United States and in conclusions says: ''Reducing this to terms of chrome ore, each thousand tons of such ore produced in California will enable us to face the Kaiser with two thousand more men.''

6. In September, 1918, the Hercules Powder Company offered to devote its advertising space in all American magazines to a statement of Franklin K. Lane, Secretary of the Interior, appealing to the producers of minerals. In response Mr. Lane wrote a communication which was published in a full page advertisement in the Mining Congress Journal of October and in many other magazines such as the Saturday Evening Post and Collier's at about that date. A facsimilie of Mr. Lane's signature appeared on the advertisement which was headed, ''Wanted—Men to Discover America.'' He discusses the country's needs, its undeveloped mineral resources, the ones most in demand at that time, mentioning in particular chrome, manganese, and pyrite. One statement which would particularly appeal to the patriotic impulse of the miner was, ''Will you save ships for the transporting and

feeding of our armies by discovering and developing our own deposits of these minerals?" The article then proceeded to point out the various states in which the different minerals might be most advantageously prospected in. The statement concluded by saying: "We have hardly begun to develop these minor resources—let us get at it in earnest."

7. In the Mining and Scientific Press, edited by T. A. Rickard and published at 420 Market street, San Francisco, the following editorial statement appeared in the issue of January 7, 1922: "We have received several letters asking for a specific reference in our pages to the government's call for the production of war minerals. It will be found on page 319 of our issue of March 9, 1918, where we quoted from a circular issued by the late Franklin K. Lane, then Secretary of the Interior. This call was to save the ships needed for war purposes, by producing the needed minerals at home and so decreasing the number of vessels occupied in the transport of minerals from foreign sources. The minerals specified by the Secretary of the Interior were manganese, flake graphite, tin, tungsten, antimony, pyrite, magnesite, potash, and nitrates. In our issue of December 29, 1917, on page 918, we discussed the production of minerals and referred to the urgency of the national demand as indicated by the steps already taken by the Geological Survey and the Bureau of Mines, acting for the government."

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

The political division, California, became known to the world as the Golden State on account of the metallic wealth within its boundaries, and the fitting creation of the State Mining Bureau for the purpose of fostering and promoting the great basic industry of mining in all its branches, speaks well of the foresight and wisdom of its founders.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the State's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the State's mineral output since the records of production were first compiled by the Bureau in 1887; and which reveal an increase in value of 1000 per cent in the last twenty-five years.

The results attained have attracted the attention of other state and foreign governments and resulted in special investigations of the organization of the Bureau for the purpose of establishing agencies of their own along similar lines.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public whose funds support it, by embodying in the monthly chapter a review of the executive activities.

The responsibility for the coordination of effort of each department to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., will therefore be included in the monthly chapter.

New publications.

During the month the following Bureau publications have been made available for distribution:

Bulletin No. 90—Mineral Production of California in 1920 with County Maps. This is for free distribution and contains information as to production, value, and uses of the various mineral substances arranged according to class of minerals, and alphabetically by counties. These data are compiled from direct returns from operators in answer to inquiries sent out by the Bureau.

Seventeenth Report State Mineralogist.

Summary of Operations, California Oil Felds, September, 1921.

Summary of Operations, California Oil Fields, October, 1921.

Oil Field Map No. 17, Santa Paula-Sespe Oil Fields, revised to November 1, 1921.

Oil Field Map No. 10, Belridge and McKittrick Front Oil Field, revised to November 1, 1921.

Oil Field Map No. 11, Lost Hills and North Belridge Oil Field, revised to November 1, 1921.

Oil Field Map No. 9, Midway-McKittrick Oil Field, revised to September 1, 1921.

Distribution of publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number Distributed
Eleventh Report State Mineralogist	3
Fourteenth Report State Mineralogist	6
Mines and Mineral Resources of Colusa, etc.	1
Mines and Mineral Resources of Del Norte, etc.	2
Fifteenth Report State Mineralogist	5
Mines and Mineral Resources of Fresno, etc.	2
Mines and Mineral Resources of Imperial, etc.	2
Mines and Mineral Resources of Alpine, etc.	2
Mines and Mineral Resources of Butte, etc.	4
Sixteenth Report State Mineralogist	1
Mines and Mineral Resources of El Dorado, etc.	3
Mines and Mineral Resources of Los Angeles, etc.	3
Mines and Mineral Resources of San Bernardino, etc.	2
Nevada County Report	5
Plumas County Report	4
Sierra County Report	5
Seventeenth Report State Mineralogist	325
Bulletin No. 6, California Gold Mill Practices	6
Bulletin No. 15, Map of Oil City Oil Fields, Fresno County	2
Bulletin No. 23, The Copper Resources of California	1
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	8
Bulletin No. 46, General Index to Publications of the State Mining Bureau	5
Bulletin No. 50, The Copper Resources of California	5
Bulletin No. 70, Mineral Production for 1914, with Mining Law Appendix	1
Bulletin No. 72, Geologic Formations of California	15
Bulletin No. 74, California Mineral Production for 1916	3
Bulletin No. 75, Mining Laws, United States and California	60
Bulletin No. 76, Manganese and Chromium in California	4
Bulletin No. 77, Catalogue of the Publications of the California State Mining Bureau, 1880-1917	3
Bulletin No. 78, Quicksilver Resources of California	5
Bulletin No. 82, Second Annual Report of the State Oil and Gas Supervisor, 1916-1917	2
Bulletin No. 83, California Mineral Production for 1917	2
Bulletin No. 85, Platinum Resources of California	10
Bulletin No. 86, California Mineral Production for 1918	5
Bulletin No. 87, Commercial Minerals of California	2
Bulletin No. 88, California Mineral Production for 1919	43
Bulletin No. 90, California Mineral Production for 1920	1685
Bulletin, Reconnaissance of Colorado Desert	1
County Maps and Registers of Mines	11
El Dorado Forest Map	2
Madera Forest Map	2
Placer Forest Map	2

Distribution—Continued.

Publications	Number Distributed
Shasta Forest Map	2
Sierra Forest Map	1
Siskiyou Forest Map	2
Tuolumne Forest Map	2
Desert Map	4
Copper Deposits Map	4
Inyo County Geological Map	9
Forest Reserve Map, Unmounted	2
Geological Map of California, Mounted	34
Minaret District; Madera County	1
Tuolumne County Map	1
Oil Field Maps	389

Mails and files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations issued by the State Commissioner of Corporations.

During the month 1416 letters were received and answered. They are practically all requests for information, and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where maps, tracings, oil well logs and similar drawings are prepared.

Changes in personnel.

The secretary is authorized by the State Mineralogist to announce the appointment of W. Burling Tucker as district engineer in charge of the Redding Field Division of the California State Mining Bureau, effective February 1, 1922, succeeding C. McK. Laizure, who has been transferred as district engineer, with headquarters at San Francisco.

Mr. Tucker, whose office will be in Redding opposite the Southern Pacific station, was in charge of the Los Angeles field division for several years previous to January 1, 1921, since which time he has been absent on leave in Mexico. He comes well prepared to carry on the local work which was first inaugurated in July, 1919. He will welcome the opportunity to become personally acquainted with the mining public of Northern California, and extends a cordial invitation to all to make his office their headquarters when in Redding.

The Mining Bureau is anxious to assist in all possible ways in the development of the mineral resources of the State. Its field engineers are authorized to give aid and advice to the extent of their ability, upon request. It is their endeavor to study the problems and difficulties encountered by operators in their district and to prepare for publication reports covering the results of their investigations.

While the northern counties of California have a mining record of which they may be well proud, it is Mr. Hamilton's belief that their possibilities in this regard have been barely indicated to date. With the industrial growth of the Pacific Coast and with increased transportation facilities such as the completion of the State highway laterals already under way, the mineral resources of this region will become even more important factors in the wealth and prosperity of the entire State than they have been in the past.

DEPARTMENT OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

Statistics.

There are some 10,000 individual producers of mineral products in California, and the task of compiling accurate and dependable statistics covering their activities is an extremely difficult one.

The Bureau's data is authoritative, all figures, with the exception of those for gold and silver, which are supplied through the courtesy of the United States Geological Survey, being obtained by direct communication with the producers.

Publication of the annual statistics of mineral production in complete form has been necessarily delayed in the past by slow returns from a few individuals, although the totals for many important products may have been fully compiled for several months, and otherwise available.

Production blanks for the year are sent out during the succeeding January, and followed up by second, third and fourth requests, when necessary, but in spite of every endeavor to advance the date of publication, the usefulness of the statistical report has been impaired by its tardiness.

With the inauguration of the monthly chapter it will be possible to publish the production figures for any mineral within a maximum period of thirty days from the date on which the returns are complete.

It is hoped that the early appearance of the figures for some of the minerals will induce other producers to cooperate, to the end that the complete statistical bulletin may be incorporated in one of the early mid-year issues of the chapter.

An estimate of the mineral production for the year just closed, in the January number, and the dissemination of data on the consumption of mineral products in California, figures for which are rarely obtainable, are features to be forthcoming.

California mineral production in 1921.

The total value of the mineral production of California for the year 1921 is conservatively estimated to have been approximately $244,856,910. This is, in part, detailed in the tabulation below; but, as there are more than fifty mineral substances on California's commercial list, it is impractical at this early date to obtain definite figures on other than the more important items. The report forms are this week being mailed out to the operators in all mineral lines, and the date of publication of the final and complete report will depend upon the promptness of their replies. The State Mining Bureau urges the hearty cooperation of all concerned, to the end that the result may be made known early.

This estimated total of $244,856,910 is an increase of $2,757,243 over the value of the 1920 production, and is due mainly to increases by petroleum, gold and silver. Preliminary reports indicate a record yield by petroleum for the year 1921. The total would have been even greater than here shown but for the strike of employees in the San Joaquin Valley fields during September and October. For the first eight months of 1921 the yield averaged 10,100,000 barrels per month.

The increase in total value for the year was not in the same proportion as the increase in quantity, because the price was somewhat lower ($1.60 per barrel against $1.73) than that for 1920. The figure here used is the average of quotations for 24 degrees gravity oil in the San Joaquin fields during 1921.

Gold mining in California has apparently passed the low point in its career, due to the war-time and post-war economic situation, and is now on the up-grade again. Reports indicate a revival in many gold districts, and the output for the year, based on eleven months' shipments, is estimated at $15,800,000, or an increase of approximately $1,500,000. Silver is estimated at $3,500,000 (at $1 per ounce), the greatest of any year (except one, 1884) in California. This is due to the persistence of high-grade ore shipments from the California Rand mine and adjacent leases near Randsburg. Copper, though decreasing about one-sixth in quantity, shows only a little over one-half the value of the previous year, due to the drop in price from an average of 18.4 cents to 12.6 cents per pound. Lead, zinc and quicksilver all show material decreases, both in quantity and in value per unit. The output of quicksilver was the lowest in the history of that metal in California, and is due directly to the competition of cheaper foreign metal imported from Spain and Italy, against which we have only a negligible tariff protection. Magnesite shows a decrease of about 25 per cent in quantity. The conditions at present confronting the domestic producers of quicksilver, magnesite, tungsten, chromite, manganese and talc (to mention only those minerals in which California is especially interested), make it necessary that a tariff should be placed on foreign importations if our domestic output of these ores is to continue.

The structural group (brick, cement, building stone, crushed rock, etc.) had some 'ups and downs' during the past year, but the prospects are for increased activity during 1922. Building work was tied up for some weeks in 1921 in the San Francisco district owing to strikes, but other parts of the state were not affected in the same degree. Active interest has been shown in the demand for many of the 'industrial' minerals and the salines.

The estimated quantities and values for 1921 are tabulated as follows:

$15,800,000	gold.
3,500,000	(3,500,000 fine ounces) silver.
1,477,710	(11,700,000 pounds) copper.
36,880	(800,000 pounds) lead.
43,520	(850,000 pounds) zinc.
113,800	(2400 flasks) quicksilver.
45,000	(500 fine ounces) platinum.
182,400,000	(114,000,000 barrels) petroleum.
3,900,000	(60,000,000 M. cubic feet) natural gas.
540,000	(54,000 tons, crude) magnesite.
27,000,000	brick, cement, building stone, crushed rock, etc.
3,500,000	miscellaneous 'industrial' minerals.
6,500,000	salines (including borax, potash, salt, soda).
$244,856,910	total.

Museum.

Each issue of the monthly chapter will contain a brief account of current museum activities. This will include a list of new acquisitions received with names of donors, a report of the number of visitors registered and other items tending to keep the public advised of the advantages, from an educational standpoint, afforded by the exceptionally fine collection of rocks and minerals of both economic and academic value, comprising the 16,000 specimens on exhibit. The museum contains not only one or more samples of practically every known mineral found in California, but hundreds of specimens from other states and foreign countries as well.

It may not be generally known that the State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the State upon request.

Aside from its purely educational features, the museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of the State.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the curator.

From December 15, 1921, to January 15, 1922, inclusive, owing to holidays, the museum was open to the public a total of twenty-two and one-half days only.

During this period 448 callers left their names and addresses on the visitors' register. The total number of visitors is unknown, as no count is kept of those who do not register, but the number of the latter undoubtedly equals or exceeds those who do.

Teachers and their classes from the various schools of the bay region are usually among the group who do not find it convenient to register.

Thirty-six states of the Union and twelve foreign countries were represented by those who gave their home addresses.

LABORATORY.

FRANK SANBORN, Petrologist.

The correct answers to the queries, What is it? and, Has it any value? questions concerning minerals sometimes incited by mere curiosity, but more often originating with those who have been pioneers in building up the mining and mineral industry of the State, have been the initial step in much of the development recorded in the past forty years.

The State Mining Bureau since its organization has supplied the necessary answer in thousands of cases without cost to the individual; and has been largely instrumental in bringing to light the minerals of both scientific interest and practical utility found in California.

Few may fail to recognize the native yellow metal, but gold now falls far short of being the premier mineral product. On the contrary, cement, one of the most unobtrusive appearing products, exceeded gold in the value of its yearly output in 1920, as has petroleum for more than a decade.

The rapid increase in the number of structural and industrial minerals and salines, whose character, use and value are seldom recognized without the aid of laboratory tests, has demonstrated the real need of this service.

The constant demand on the laboratory facilities in the past has been gratifying, but it is believed that its usefulness will be increased if the results of its work are published.

A monthly laboratory report, summarzing the determination made, with notes on those of possible commercial value or scientific interest and other items, will therefore appear in this and subsequent issues of the Monthly Chapter.

During the thirty-day period covered by this report, which included more than the usual number of holidays, a total of 275 qualitative determinations were made on samples sent to the Bureau from practically every county in the State.

The number is somewhat above the average for this season of the year, when prospecting in many sections is impossible, and indicates an apparent healthy interest in the industry by those in the hills.

Samples submitted were of great variety, ranging from gem stones to paint pigments, and, as may be expected, the larger number were of doubtful commercial value.

A list of those of possible value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05– 1	Volcanic ash—contains some potassium.
05– 2	Mica–schist.
05– 3	Copper ore.
05– 4	Sphalerite—zinc sulphide.
05– 5	Hematite—iron ore.
05– 6	Silver–lead ore.
05– 7	Limonite—yellow ocher.
05– 8	Asbestos—amphibole variety.
05– 9	Copper ore—contains some gold and silver.
05–10	Chromite, also biotite mica.
05–11	Silica, with soluble sodium salts.
05–12	Limestone—good grade.
05–13	Volcanic ash—contains some potassium.
05–14	Volcanic ash—contains some potassium.
05–15	Talc—very good grade.
05–16	Limonite—yellow ocher.
05–17	Lead ore—some copper and silver.
05–18	Volcanic ash—some potassium present.
05–19	Manganese ore.
05–20	Copper—lead-silver ore, also volcanic ash.
05–21	Asbestos—amphibole variety.
05–22	Copper ore, also gold-bearing sand.
05–23	Limestone—possibly lithographic, also copper ore
05–24	Strontium ore, also volcanic ash and limestone.
05–25	Gold ore, also platinum.
05–26	Gold-silver-lead-copper ore.
05–27	Hydrous aluminum silicate—clay.
05–28	Ferruginous shale—paint pigment.
05–29	Gypsum.

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of Federal and State governments and of educational institutions, both domestic and foreign.

It is not the scarcity of the latter publications, but rather the lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with the above source of current technical information, the Monthly Bulletin will contain under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will also be found in the library and county and state maps, topographical sheets, geological folios and current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

Official publications received.

Eighth Biennial Report, 1920-1921, of the Director of the State Geological Survey to the Mississippi Legislature.

Production of Coke and Coal in Canada, Canada Department of Mines.

Proceedings of the Second Annual National Mine Tax Conference, at the Twenty-fourth Annual Convention of the American Mining Congress, Chicago, Illinois.

Oil Bradstreet and Mining Directory for 1921.

Proceedings of the American Philosophical Society of Philadelphia.

Department of Geology of the University of California, Vol. 12, No. 5—Extinct Vertebrate Faunas of the Badlands of Bautista Creek and San Timeteo Canon, Southern California.

Thirty-first Report of the State Inspector of Mines of South Dakota.

U. S. Commerce Reports.

Monthly Summary of Foreign Commerce of the United States.

Bulletin No. 726-F., U. S. G. S.—Structure and Oil and Gas Prospects of a Part of Jefferson County, Oklahoma.

Bulletin No. 722-C—Ore Deposits of the Salmon River, Portland Canal Region, Alaska.

U. S. National Museum Bulletin No. 82—A Monograph of the Existing Crinoids.

Bulletin No. 187, U. S. B. M.—Treatment of the Tungsten Ores of Boulder, Colo.

Proceedings of the Rochester Academy of Science, Vol. 6, No. 2—Minerals in the Niagara Limestone of Western New York.

Official publications received—Continued.

Reports of Investigations, U. S. Bureau of Mines—

- Serial No. 2298—Lignite Carbonization, Carbonized Residue Briquets.
- Serial No. 2299—A Fatal Quarry Accident from Falling Rock.
- Serial No. 2300—Underground Loading Devices in Metal Mines.
- Serial No. 2301—Destructive Distillation of Mixtures of Oil and Coal.
- Serial No. 2302—Inspection and Assembly of Flame Safety Lamps at the Mine.
- Serial No. 2303—Methane in California Gold Mines.
- Serial No. 2304—The Treatment of Carbon Monoxide Poisoning.
- Serial No. 2305—Recent Articles on Petroleum and Allied Subjects.

Mineral Industries Map, State of Illinois. State Geological Division.

U. S. Topographic Sheets—

- Brooklet, Ga.
- Los Banos, Cal.
- Scotts City, Mo.
- Volta, Cal.
- Clarks Hill, S. C.
- Rives Junction, Mich.
- Suncook, N. H.
- Jamesburg, Cal.
- Saddlebuck Hills, Wyo.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, with the exception of cases where the functions of both are controlled or carried on by the same ownership.

Such exceptions are comparatively rare, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Insufficient publicity has heretofore been given to this feature of the Bureau's work. Through the medium of the monthly chapter, however, it will now be possible to give a wider circulation to current inquiries of this nature, and with that purpose in view, written or verbal inquiries that come to the attention of the Bureau will be summarized in each issue.

The name of the product wanted or offered only will be published, the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral products or deposits for which a market is sought.

02- 1	Ball Mill Pebbles.
02- 2	Bentonite—large deposit.
02- 3	Borax.
02- 4	Chrome Ore—high grade.
02- 5	Clay—bauxitic.
02- 6	Feldspar.
02- 7	Fluorspar.
02- 8	Gold Prospect—sale or lease $35 ton.
02- 9	Graphite.
02-10	Mica—muscovite.
02-11	Mineral Paint—paint rock.
02-12	Vesuvianite—Californite, gem material, selected grade.
02-13	Asbestos—in Inyo County.
02-14	Cement Copper.
02-15	Feldspar—good grade.
02-16	Firebrick and Tile.
02-17	Graphite.
02-18	Graphite.
02-19	Iron Deposit—in California.
02-20	Molybdenum Deposit.
02-21	Oil Shales—and capital to develop.
02-22	Placer Gold Property—will lease.
02-23	Oil Shale Deposit.
02-24	Sulphur—25 per cent to 60 per cent.
02-25	Asphalt—natural.
02-26	Fine Granite Sand.
02-27	Manganese and Antimony Ores.
02-28	Silica—large deposit near railroad.
02-29	Stamp Mill Tailing Dump—60,000 to 80,000 tons, average $3.

Mineral products or deposits for which a market is sought—Continued.

02–30 Crude Soapstone.
02–31 Off color Barite.
02–32 Quartz Cobbles.
02–33 Chromite—high grade, 50 per cent $Cr_2 O_3$.
02–34 Crushed greenstone, one-quarter inch to dust.

Mineral products or deposits wanted.

03– 1 Agate.
03– 2 Asbestos—fiber.
03– 3 Chrome—about 150 tons high grade.
03– 4 Cobalt Ore.
03– 5 Dolomite.
03– 6 Gypsum—deposit of.
03– 7 Lime.
03– 8 Magnesite.
03– 9 Magnesite—carload lots.
03–10 Magnesite—refractory.
03–11 Manganese Ore 83 per cent or over, iron less than 1 per cent, copper less than .03 per cent, low in silica.
03–12 Mica—Biotite (black iron mica).
03–13 Onyx.
03–14 Sulphur.
03–15 Asbestos Deposit.
03–16 Clay, Ground Feldspar and Ground Flint—tonnage.
03–17 Clay Deposit.
03–18 Coal—deposit in California.
03–19 Fuel Gas Supply.
03–20 Gold Placers—in California.
03–21 Oil Sand—deposit.
03–22 Pyrite—in Southern California.
03–23 Roofing Slate, Marble, Onyx, Travertine—undeveloped.
03–24 Tar Sands—deposit.
03–25 Tar Sands—deposit.
03–26 Mariposite (green)—vicinity of Auburn.
03–27 White grinding Barite—deposit.

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch office, in 1919 a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Announcement of the above service was made in press bulletins at the time, but due to the fact that no direct means were at hand for keeping the mining public advised of the service, and to the general stagnation in the industry during the past two years, the facilities offered were not used to the extent anticipated. However, a total of 156 technical men took advantage of the opportunity to register during 1920–1921, and notices of 16 'positions open' were received from employers during the same period, and applicants placed in touch with them.

With the brighter outlook facing the industry in 1922, and the publication of a monthly chapter of the State Mineralogist's report, it is believed that the service will become of increasing value. The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the monthly chapter, will be carried in each issue.

Each notice will be designated by a key number, and communications sent to the Bureau addressed to any key number will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–1—Draftsman, can also fill position combining typing and office work; age 27; four and one-half years experience railway, military and mining drafting; references; salary wanted $135.

01–2—Anything connected with geology; student; age 20; no experience.

01–3—Mine surveyor or engineer; graduate; age 26; two years varied experience oil and mining.

BUREAU PUBLICATIONS.

During the past forty-two years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Pacific Finance Building, Los Angeles; in Santa Maria, Santa Paula, Coalinga, Taft, Bakersfield, Auburn and Redding. They may also be found in many public, private and technical libraries in California and other states and foreign countries.

A catalog of all the publications of the Bureau from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

A list of the above, most of which are out of print, as well as those still in stock, both for free distribution and sale, revised to the date of publication, will appear in each issue of the monthly chapter.

Publications may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications which have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

FEBRUARY, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and its publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. Burling Tucker, Mining Engineer

The work of the Redding field division was greatly curtailed due to the fact that the successor appointed to the position of district engineer did not take up his duties until the first of February, so the time in which to get in touch with the different operators in this district was very limited. During the early part of February the northern part of the State was visited by heavy rain and snow storms, making it impossible to cover any outside territory in the Redding field division.

The following notes cover operations during the past thirty days that have come to the personal attention of the district engineer:

Shasta County.

There is no indication of an early resumption of copper mining in Shasta County, only a small amount of work is going on at a few of the properties, but this is largely of a maintenance character. The copper mining companies are awaiting an improvement in the price of copper before attempting operations.

The aerial tramway extending from the *Hornet mine* of the Mountain Copper Company to Mathewson, a station on the Southern Pacific Railroad has been completed and placed in commission. It is 2½ miles in length, and has a capacity of 100 tons per hour, and replaces the old Iron Mountain Railroad, used by the company for ore shipments for many years. The company is shipping 500 tons of pyritic ore daily to chemical plants near San Francisco. M. J. Murphy, manager of the Mountain Copper Company, is in charge of operations.

At the *Bully Hill mine*, the Shasta Zinc and Copper Company has renewed construction work on the zinc oxide plant that was practically completed the latter part of 1921.

A number of changes and additions are to be made in the present plant to enable the company to produce a high-grade zinc-oxide product. The company expects to have the plant under operation within four months. Fifty men are employed, under the supervision of G. T. Jackson, manager.

There is quite a revival in gold mining in the French Gulch district, and a number of properties are being reopened, and active development operations are under way at the Gladstone, Milkmaid, Sybil, and Washington mines.

The *Gladstone mine* is under option to the French Gulch Mining Company, offices Mills Building, San Francisco. Frederic Searles, president; W. M. Simpkins, secretary. The mine is being unwatered and retimbered, and an active development campaign is planned by the management. Twenty-five men are employed. A. F. Duggelly, superintendent.

The *Milkmaid* and *Franklin Group* of mines are under option to Captain H. E. Smith of Shasta, California. The Milkmaid shaft is being unwatered, and the underground workings are being retimbered, and development work is under way.

The ten-stamp mill on the property has been repaired, and the mill has been put in operation on ore from the dumps, which is reported to carry values of from $4 to $6 per ton. Twelve men are employed. Roy Leach, superintendent.

The *Sybil* and *Niagara mines* are being operated by Harry M. Thompson and associates. The development work on these properties is progressing in a satisfactory manner, and it is reported that some rich ore has been struck in the Sybil mine. Fifteen men are employed.

The *Washington mine* in the French Gulch district is under bond to Thomas Salisbury and associates of San Francisco, and the property is being developed. Six men are employed on the development work.

The *American Gold Dredging Company's* dredge, on the Sacramento River, near Redding, which has been idle since February, 1921, resumed operations the first of February. Three shifts have been put on.

The *Noble Electric Steel Company* at Heroult, Shasta County, are shipping an occasional carload of iron ore to Los Angeles.

H. C. Austin who is operating a baryte deposit at Barium, near Copper City, Shasta County, is shipping two cars of ore per week to Oakland and San Francisco.

The freight rate on barytes from Barium to Oakland and San Francisco has been reduced by the Southern Pacific Railroad Company from 23 cents per 100 pounds, carload lots, to 20 cents.

Trinity County.

The hull of the *Gardella dredge* near Lewiston, Trinity County, has been completed and the machinery will soon be installed.

Many small gold properties throughout Shasta, Trinity and Lassen counties are being opened up. Prospecting throughout the different gold districts promises to be very active this spring and summer.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

The past month has been marked by two severe storms and unusually cold weather for this region. For the first time in many years snow lay on the ground for a week at Auburn. At present there is eight feet of snow at Blue Canyon and eleven and one-half feet at the Summit, with proportionate amounts all through the mountains.

There has been widespread interruption of telephone and electric service and water supply. Freezing and breaking of water ditches has been a hindrance to placer mining, and there has been some shortage of water used for power purposes at Grass Valley as well as interruptions to mining at some Mother Lode mines which depend on hydroelectric plants in the mountains.

At the same time, the heavy snowfall, which has been well packed by rain and cold weather, promises a fine supply of water for placer mining, power and irrigation during the coming season.

Work on most mines and prospects that are not equipped for steady operation in all kinds of weather is suspended in the mountain counties where the snow line is unusually low this year, and the mines that are working in the snow belt are cut off from the outside world. The spring activity at many small mines along the Mother Lode has already set in where roads are passable, and is a cheering omen in districts that have lain idle for years. Some work is also promised on the East Belt in Tuolumne County. The following items have been noted during the month. Many of the properties named have been covered in detail in our former reports.

El Dorado County.

There are no large mines operating in the county at present but a number of small outfits have become active. Besides the Grit mine and the Argonaut mine which have been described in previous reports, the following operations were going on early in February. The Grit mine has been closed down on account of financial difficulties and a lawsuit has been started by the minority stockholders. Five stamps were hauled to the mine to be added to the five previously in operation, but have not been put up.

Machinery has just been hauled to the property owned by *Samuel Akin* and others in the Cold Springs district four miles west of Placerville. Wolf and Levy were employing several men early in February.

Five stamps were running at the *Bonanza mine* on the Cosumnes River at Nashville, near the county line. This property began work since the first of the year. C. E. Padilla is the owner.

Work is going on at the *Gold Hill mine* three miles northeast of Kelsey near Travis Creek. C. N. and F. P. Brust of Kelsey own the property.

Some good ore has been crushed lately in a small two-stamp mill at the *Gold Star mine,* formerly known as the *Coe Hill mine,* a mile southwest of Garden Valley. A. Tetrault of Placerville and associates began work here in the late fall. There are a number of veins on which shallow shafts and holes have been sunk. Fifty tons milled from the dump of a shaft 50 feet deep and from a tunnel 125 feet long is said by Tetrault to have paid $7 a ton in free gold, the concentrate not being saved. All the veins prospected are said to pan well in gold, but the ore milled was from only one vein.

The five-stamp mill working on rock from the dump of the *Havilah mine* at Nashville has been increased to ten stamps.

The *Jones mine* near Diamond Springs is being reopened under the direction of J. Quinn.

The *Lookout mine,* three miles south of El Dorado, is being worked by a few men under the supervision of the owner, Seymour Hill of El Dorado.

Some small placer mines are worked in the county each year when water is available. Early in February one of these properties produced two pieces of gold weighing 23 ounces and 16 ounces respectively.

Some good gravel is reported to have been found lately in the *Hook and Ladder mine* at Smiths Flat, but whether or not this is in important quantity has not yet been determined.

Nevada County.

Material from the dumps of one of the old copper mines at Spenceville was being shipped to the bay cities early in the month. The ochre in this dump material is to be used for making paint.

The prospect tunnel at the *Penn-California gravel mine* at Willow Valley has reached a length of 2700 feet. Some gravel encountered near the face of the tunnel is now being prospected by crosscuts.

A report from Grass Valley early in the month stated that King C. Gillette has again taken an option on the *California mine* west of Grass Valley in the Rough and Ready district. Several years ago he did considerable work on this property, which has lain idle since.

Placer County.

A resumption of work is promised at the old *Marguerite mine* near Penryn. This mine was worked in the sixties and had been abandoned for many years. Last year it was unwatered and kept dry long enough to permit sampling, but the quartz in reach had been mined and milled by the former operators and the sampling was not conclusive.

Some shipments of low grade ore from the *Dairy Farm mine* have been made lately. The ore was mined several years ago and since then has been lying beside the railroad north of Sheridan.

A stock company has been prospecting in search of the Grizzly Flat channel near the old *Morning Star mine* in the Iowa Hill district. To date occasional pan prospects have been reported, but no large body of pay gravel.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Contra Costa County.

Mountain Copper Company: Home office, 332 Pine street, San Francisco. This company, which for many years has operated a copper smelter near Martinez, is said to have recently been carrying on experiments that will probably result in the addition of another product to the company's output. The sulphide ores from their mines in Shasta

County, which contain a high percentage of iron, have been subjected to a treatment worked out by the company's chemists, which results in the production of an iron oxide pigment. So far, red is the only color which has been produced, but it is believed that it will be possible to make pigments of various colors.

Napa County.

Standard Portland Cement Company: Home office, Pacific Building, San Francisco, is reported to be dismantling its plant at Napa Junction, which formerly was a large producer of cement, but which has been idle since 1918. It is understood that in the future this company's operations will be confined to its plant at Davenport thirteen miles northwest of Santa Cruz.

San Benito County.

California Asbestos Mining Company: Norris K. Davis, president, home office, 400 Seventh street, San Francisco. This company has taken a lease and bond on four claims on Clear Creek near Hernandez, owned by the Liberty Asbestos Company, and commonly known as the *Long-Ryan mine.* Considerable chrysotile ore has been developed by open cut methods, and the company is now constructing a mill of the revolving hammer type in which it is planned to reduce the ore at the property and ship nothing but clean fibre.

San Mateo County.

American Manganese Products Company: Main office, 350 Post street, San Francisco; engineering office, 405 Hobart Building, San Francisco; and works, Redwood City, California. Emory Winship, president; A. G. Suydam, consulting engineer; E. H. Westling, chief chemist, W. Chestnut street, Redwood City. This company has been experimenting for the past eight months with a patented process developed by Mr. Westling for the manufacture of chemical manganese dioxide from the low-grade siliceous manganese ores characteristically found in California. The preliminary work is nearing completion and it is believed that production on a commercial scale will soon be a reality.

Briefly, the method of manufacture employed consists of wet grinding of the crude manganiferous ore; passing SO_2 gas through the pulp thereby converting the manganese compounds present to manganese sulphate, in solution, leaving behind the silica which is removed by filtration; adding calcium nitrate (supplies of which are imported from Norway) to form manganese nitrate, which remains in solution; and heating the solution to a temperature sufficiently high to drive off the N_2O_4 fumes, leaving MnO_2 as the dry residue. The nitric oxide fumes are passed through water, making nitric acid as a valuable by-product. Twelve men are employed.

West Coast Porcelain Manufacturers: Henry Weiss, manager, Millbrae, California. Sales office, Rialto Building, San Francisco. The plant owned by this company is on the main line of the Southern Pacific Railroad and was built in 1918 for the manufacture of sanitary ware. Clays used come from Amador and Riverside counties, and from England. The company is glad to receive and test samples of California clays which might meet their requirements as raw materials. An average of eighty men is employed.

Tulare County.

Kaweah Molybdenum Mines Company: Edwin Letts Oliver, president; L. V. Riddle, secretary; home office, 619 Crocker Building, San Francisco. This company owns sixteen unpatented claims and one mill site in the Mineral King district, T. 25 S., R. 31 E., the nearest post office being the town of Three Rivers. Lemon Cove, forty-eight miles west of the property, is the railroad shipping point. According to development work which has been done since the discovery of the deposit in 1916, it is a wide dissemination of molybdenite in granite, which has been proved to have a surface extent of more than 500 x 2000 feet. The average elevation of the claims is 9500 feet. Timber for all purposes is available within a distance of two miles and there is an adequate water supply.

The company has just completed plans for the installation of a ten-inch pipe line which will be capable of generating 250 horsepower. The country is rugged and the winters are severe, although operations could be carried on throughout the year if proper preparations were made. The equipment at the present time consists of camp buildings and tools for hand mining only, and work thus far has been done in the summer months. A considerable tonnage of ore carrying a minimum of five per cent molybdenite has already been developed by open cut methods.

LOS ANGELES FIELD DIVISION.

M. A. Newman, Mining Engineer.

That mining is gradually coming back there is no doubt. The writer found evidence of this, both in the mountain and desert mining districts of southern California. True, the prospector is not seen in numbers comparable to the prewar period, but he still exists and his ranks are being gradually increased.

Imperial County.

In the Chocolate Mountains in Imperial County, the tailings of the *Paymaster mine* are being cyanided.

At the *True Friend mine* in the Poorman district of the Chocolate Mountains, Imperial County, a shaft sunk to a depth of 12 feet shows a vein 14 feet wide, assaying 20 ounces silver per ton. This shaft is now being sunk to a depth of 150 feet. The property shows all the earmarks of making good. It shows values over an outcrop 1000 feet in length. The vein occurs as a contact between diorite and schist. The property is controlled by Messrs. Beal and Byron of Brawley, Imperial County.

Fifteen miles west from El Centro, Imperial County, on the San Diego and Arizona Railroad, is a station called Maria. From here a narrow-gauge railroad is being built to the gypsum deposit of the *Imperial Gypsum Company*, 25 miles distant. To date, ten miles of this road has been built, and the road will probably be completed within the next ninety days. The Imperial Gypsum Company is to be congratulated on the immense deposit which it possesses. There is no question that the tonnage runs into the millions—for that the writer will vouch. As to the purity of the gypsum, the company claims better than 98% gypsum. As the company is in the hands of reputable business men, it hardly seems probable that they would have committed themselves to the expenditure of several hundred thousand dollars for a railroad unless they had satisfied themselves as to the purity of this gypsum deposit. Mr. Coons of Bakersfield and S. W. Dunaway of El Centro are respectively president and vice president of the company.

Kern County.

Jo Rand Smelting Company: Information that the Jo Rand Smelting Company, a new corporation, incorporated under the laws of the State of California, is going to build a modern smelter at Mojave will be received with the greatest interest and satisfaction by mine owners and operators in Inyo, Kern and San Bernardino counties, and adjacent sections in Nevada and Arizona, as there are a great number of properties containing thousands of tons of low-grade gold ores, silver ores, and lead-silver ores blocked out in mines of this district, which under past and present conditions can not be shipped to the distant reduction plants at a profit. Both the Southern Pacific Company and the Santa Fe Railroad Company have established commodity rates from shipping points in Arizona, Nevada, and adjacent points in Inyo, San Bernardino and Kern counties to Mojave. These rates will result in a tremendous saving to operators in these districts, and under the circumstances a tremendous revival of mining of low-grade ores in the Calico, Johannesburg, Daggett, Fenner, Oatman, Kingman, El Paso, Slate Range, Cerro Gordo, Darwin, Big Pine, and other sections can be looked forward to.

The officers of the Jo Rand Smelting Company are well known throughout the West in mining and industrial circles, and are as follows: Mr. Bela Kadish, president, Los Angeles; Mr. W. J. Grindle, vice president, Los Angeles; Mr. R. L. Gilmore, secretary and treasurer, Bakersfield; Mr. Geo. Bush, director, Sacramento.

Mr. Kadish, the president, was vice president and executive officer of the North Port Smelting and Refining Company in British Columbia for many years, and was at one time owner and president of the Goldfield Sampling Works at Goldfield, Nevada.

Mr. Grindle, the vice president, is widely known throughout the West as a successful oil and mining operator. Is now operating in Inyo County and in Nevada at Battle Mountain, and is president of the Calitroleum Oil and Gas Company, and president of the Bangor Oil Company.

Mr. Gilmore, the secretary and treasurer, is a consulting mechanical engineer, and is well known on the Pacific Coast, and will have active charge of construction and other details.

Mr. Geo. Bush, director, is legislative counsel for the State of California, as well as a director in several large corporations.

The main office will be located in Bakersfield, and active construction is to start at once on the plant. The initial units of the plant will have a capacity of two hundred tons per day and all smelting will be done upon a lead basis.

San Bernardino County.

In the Randsburg district, 2250 feet south of the California Rand Silver Company (the *Kelly mine*) is the *Silver Dyke Group*, consisting of three claims. This group is being developed by a shaft, which at a depth of 30 feet has 12-ounce silver ore for its full width. As the outcrop showed but a few ounces of silver per ton, the owners of this group feel every reason to be elated over the favorable development to date.

A very promising prospect in the West Calico district, San Bernardino County, is the *Silver Contact mine.* This is being developed by Mr. H. M. Holmes. A shaft is now being sunk and has maintained an averaged value of 20 ounces silver and 8% lead from the start. These values represent a width of about 4 feet.

San Diego County.

The Julian district of San Diego County will in the near future see considerable activity. A fine concrete highway is now being built into the district and this will link it directly with San Diego and solve its transportation problem.

The *Hubbard mine* in this district has commenced operations, and W. M. Van Dyke has erected an experimental flotation plant to test out the Julian district base ores.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

The record of new wells started since January 1, 1922, shows a marked tendency toward curtailment of development operations in San Joaquin Valley fields and considerable drilling activity in the three new southern fields, Huntington Beach, Long Beach and Santa Fe Springs. From the above must be excepted the Elk Hills oil field, in Kern County, where drilling operations are active.

The Elk Hills oil field is one of the most important sources of petroleum and natural gas in the state. The easterly portion of the field deserves special comment. It has the highest average daily production of oil per well of any oil field in the state and the lowest production of water per well. The average daily production of oil per well is 415 barrels and of water less than 2 barrels.

At Santa Fe Springs, although there is a great deal of drilling activity, the discovery well of Union Oil Company, 'Bell' 1, is the only well producing in the newer part of the field as of February 15, 1922. This well is flowing 3000 barrels of oil per day of 35 degrees Baumé under a pressure of 650 pounds per square inch.

The gas zone at Santa Fe Springs, lying above the main producing oil sand, has hindered development considerably. In the vicinity of the discovery well the gas zone is entered at depths between 2000 and 2500 feet. While drilling through the gas zone with rotary tools, Union Oil Company has had two serious blow-outs, wrecking wells 'Alexander' 1 and 'Bell' 2 and forming craters where the derricks once stood.

Since January 1, 1922, up to February 11, 1922, the following new wells have been reported ready to drill:

Company	Section	Twshp.	Range	Well	Field
ALAMEDA COUNTY:					
Atlantic and Western Oil Co.	6	25	3	1	Alameda County
FRESNO COUNTY:					
West Coalinga Oil and Dev. Co.	6	21	15	2	Coalinga
Coalinga Kern Oil Co.	14	20	14	5	Coalinga
Helen D. Oil Co.	22	13	11	1	Fresno County
KERN COUNTY:					
Associated Oil Co.	26	31	23	51	Midway
Associated Oil Co.	26	31	23	71	Midway
Shale Hills Development Co.	2	27	18	1	Kern County
Coalinga-Kern Oil Co.	21	28	28	5	Kern River
Shell Co.	28	27	22	4	Kern County
Honolulu Consolidated Oil	6	22	24	61	Midway
Honolulu Consolidated Oil	6	22	24	71	Midway
C. C. M. O. Co.	22	31	22	17	Midway
Honolulu Consolidated Oil	6	32	24	6	Midway
Union Oil Co.	34	31	23	10	Midway
Myron A. Folsom	32	31	24	1	Midway
C. T. Dougherty	19	25	18	1	Kern County
Comanche Point Oil Co.	23	32	29	1	Kern County
Standard Oil Co.	11	28	27	2	Kern River
Caliposo Petroleum Co.	18	28	28	1	Kern River
Tarr & McComb, Inc.	8	29	28	6	Kern River
Union Oil Co.	4	11	23	2	Sunset
Union Oil Co.	32	31	24	3	Midway
Associated Oil Co.	26	31	23	4	Midway
Union Oil Co.	26	30	24	2	Elk Hills
Honolulu Consolidated Oil Co.	14	32	24	81	Midway
C. J. Berry	34	12	24	6	Sunset
Taft Oil Co.	25	25	18	3	Devils Den
Taft Oil Co.	25	25	18	4	Devils Den
Taft Oil Co.	25	25	18	5	Devils Den
Taft Oil Co.	25	25	18	6	Devils Den
Taft Oil Co.	25	25	18	18	Devils Den
Pacific Oil Co.	31	31	24	12	Midway
Pacific Oil Co.	31	31	24	20	Midway
Pacific Oil Co.	1	32	23	29	Midway
Pacific Oil Co.	1	32	23	27	Midway
Pacific Oil Co.	1	32	23	23	Midway
Murvale Oil Co.	28	31	23	M-5	Midway
Murvale Oil Co.	12	32	23	M-11	Midway
Associated Oil Co.	26	30	24	41	Elk Hills
Standard Oil Co.	31	27	28	2	Kern River
Pacific Oil Co.	35	30	24	16	Elk Hills

Company	Section	Twshp.	Range	Well	Field
Pacific Oil Co.	35	30	24	14	Elk Hills
Pan-American Petroleum Co.	1	31	24	1-E	Elk Hills
Pan-American Petroleum Co.	6	31	25	2-C	Elk Hills
Honolulu Consolidated Oil Co.	14	32	24	9	Midway
Pacific Oil Co.	5	11	23	2139	Sunset
C. C. M. O. Co.	22	31	22	14	Midway
Tannehill Oil Co.	34	12	24	21	Sunset
Totem Oil Co.	30	25	19	2	Devils Den
KINGS COUNTY:					
Turner and Goldsberry	8	17	23	1	Kings County
Interstate Oil Co.	15	32	23	9	Midway
Dougherty and Co.	36	28	27	5	Kern River
Union Oil Co.	11	28	27	Water well	Kern River
Giffen-Kaine Syndicate	13	28	27	1	Kern River
Associated Oil Co.	34	31	23	76	Midway
Associated Oil Co.	34	31	23	56	Midway
Associated Oil Co.	22	31	23	21	Midway
Big Chief Oil Co.	2	11	24	5	Sunset
Blair Oil and Refinery Co.	23	32	23	1	Midway
Tarr & McComb	8	29	28	7	Kern River
LOS ANGELES COUNTY:					
Petroleum Midway Co., Ltd.	19	4	12	1	Long Beach
Ocean View Oil Co.	30	2	10	2	Whittier
St. Helens Riverside Prop.	2	2	12	8	Montebello
Prudential Petroleum Co.	29	4	12	1	Long Beach
Colorado Oil Co.	22	2	11	12	Whittier
Interstate Oil Co.	29	4	12	1	Long Beach
Big Jumbo Oil Co.	29	4	12	1	Long Beach
General Petroleum Corp.	19	4	12	Signal 1	Long Beach
General Petroleum Corp.	19	4	12	1	Long Beach
Temescal Oil Co.	29	4	12	1	Long Beach
Sawtelle-Santa Monica Oil Syndicate	32	1	15	1	Los Angeles County
Shell Co.	29	4	12	Andrews 1	Long Beach
Shell Co.	29	4	12	Bixby 1	Long Beach
Shell Co.	29	4	12	1	Long Beach
Cal-Mex Oil and Refining Co.	19	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	6	3	11	1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Foix 1	Santa Fe Springs
Andrews Petroleum Corp.	17	3	16	8	Newhall
Union Oil Co.	32	3	11	1	Santa Fe Springs
Union Oil Co.	31	3	11	5	Santa Fe Springs
Union Oil Co.	31	3	11	1	Santa Fe Springs
Thos. A. O'Donnell	29	4	12	1	Long Beach
Puente Hills Oil Syndicate	16	2	10	1	Los Angeles County
General Petroleum Corp.	5	3	11	4	Santa Fe Springs
C. C. M. O. Co.	8	4	14	1	Redondo
Union Oil Co.	29	4	12	1	Long Beach
Union Oil Co.	31	2	11	4	Santa Fe Springs
C. C. M. O. Co.	9	4	14	1	Redondo
Shell Co.	29	4	12	1	Long Beach
St. Helens Petroleum Co.	2	2	12	1	Montebello
General Petroleum Corp.	5	3	11	2	Santa Fe Springs
General Petroleum Corp.	5	3	11	3	Santa Fe Springs
General Petroleum Corp.	6	3	11	1	Santa Fe Springs
Union Oil Co.	6	2	11	2	Santa Fe Springs
United Oil Co.	19	4	12	1	Long Beach
R. R. Bush Co.	20	4	12	1	Long Beach
Walsh Petroleum Co.	25	1	13	1	Los Angeles Count
Holms and Co.	29	4	12	1	Long Beach
Schroeder Oil Syndicate	4	3	16	1	Newhall
Petroleum Midway Co., Ltd.	30	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	29	4	12	1	Long Beach
Amalgamated Oil Co.	6	3	11	1	Santa Fe Springs
Amalgamated Oil Co.	5	3	11	1	Santa Fe Springs
Amalgamated Oil Co.	5	3	11	3	Santa Fe Springs
White Oil Syndicate	29	4	12	1	Long Beach
Great Angelus Oil and Land Corp	21	8	9	1	Los Angeles County
Coalinga Mohawk Oil Co.	31	2	11	Campos 1	Santa Fe Springs
Coalinga Mohawk Oil Co.	31	2	11	1	Santa Fe Springs
Geo. F. Getty	29	4	12	1	Long Beach
NAPA COUNTY:					
Griffiths Oil Co.	29	8	3	3	Napa County
Griffiths Oil Co.	29	8	3	4	Napa County

Company	Section	Twshp.	Range	Well	Field
ORANGE COUNTY:					
Petroleum Midway Co., Ltd.	35	5	11	2	Huntington Beach
Petroleum Midway Co., Ltd.	2	6	11	2	Huntington Beach
Petroleum Midway Co., Ltd.	29	3	9	15	Richfield
Miley-Keck Oil Co.	2	6	11	6-A	Huntington Beach
Union Oil Co.	34	5	11	11	Huntington Beach
Union Oil Co.	33	3	9	4	Richfield
Union Oil Co.	34	5	11	4	Huntington Beach
Amalgamated Oil Co.	28	3	9	Bayha 2	Richfield
Amalgamated Oil Co.	28	3	9	2	Richfield
Standard Oil Co.	25	3	9	15	Richfield
Standard Oil Co.	2	6	11	5	Huntington Beach
Amalgamated Oil Co.	2	6	11	12	Huntington Beach
Eddystone Oil Corp.	2	6	11	4	Huntington Beach
Eddystone Oil Corp.	34	5	11	4	Huntington Beach
Standard Oil Co.	3	6	11	10	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Clark 1	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Snyder 1	Huntington Beach
Petroleum Midway Co., Ltd.	2	6	11	Pearce 1	Huntington Beach
Amalgamated Oil Co.	28	3	9	2	Richfield
Bolsa-Chica Oil Co.	11	6	11	2	Huntington Beach
Union Oil Co.	29	3	9	3	Richfield
Standard Oil Co.	32	3	9	17-A	Richfield
Rio Bravo Oil Co.	35	5	11	1	Huntington Beach
Standard Oil Co.	34	5	11	9	Huntington Beach
Standard Oil Co.	2	4	11	1	Orange County
Petroleum Midway Co., Ltd.	35	5	11	1	Huntington Beach
Petroleum Midway Co., Ltd.	33	3	9	7	Richfield
Dolke-Thomas Oil Syndicate	27	3	10	1-A	Coyote Hills
Olinda Land Co.	9	3	9	24	Brea Olinda
Rhoads Oil Co.	11	6	11	5	Huntington Beach
SAN MATEO COUNTY:					
W. A. Sage	Cassenelli Ranch			1	San Mateo County
SANTA BARBARA COUNTY:					
Puritan Oil and Refining Co.	Hope Ranch			1	Santa Barbara Co.
SANTA CLARA COUNTY:					
Douglas S. Watson	5	12	4	1	Santa Clara County
SONOMA COUNTY:					
Sage & Olson	Miller Ranch			1	Sonoma County
VENTURA COUNTY:					
J. N. Bissell	33	2	20	1	Conejo
Ada Oil Association	34	2	20	2	Conejo
Ada Oil Association	34	2	20	3	Conejo
Ada Oil Association	34	2	20	4	Conejo
Ada Oil Association	34	2	20	5	Conejo
Oak Ridge Oil Co.	13	3	21	8	South Mountain
Wilson Development Co.	6	2	17	1	Simi
Camarillo Refining and Pet. Co.	27	2	20	1	Conejo
Cooper Petroleum Co.	33	2	20	37	Conejo
E. R. Carey	2	1	21	1	Conejo
Calumet Oil Co.	3	3	19	12	Bardsdale
Cooper Petroleum Co.	33	2	20	39	Conejo
H. A. Singer	28	2	20	1	Conejo
Cline & Clemson	14	2	18	1	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff, containing much information that will add to the permanent value of the Monthly Chapter, are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations; as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

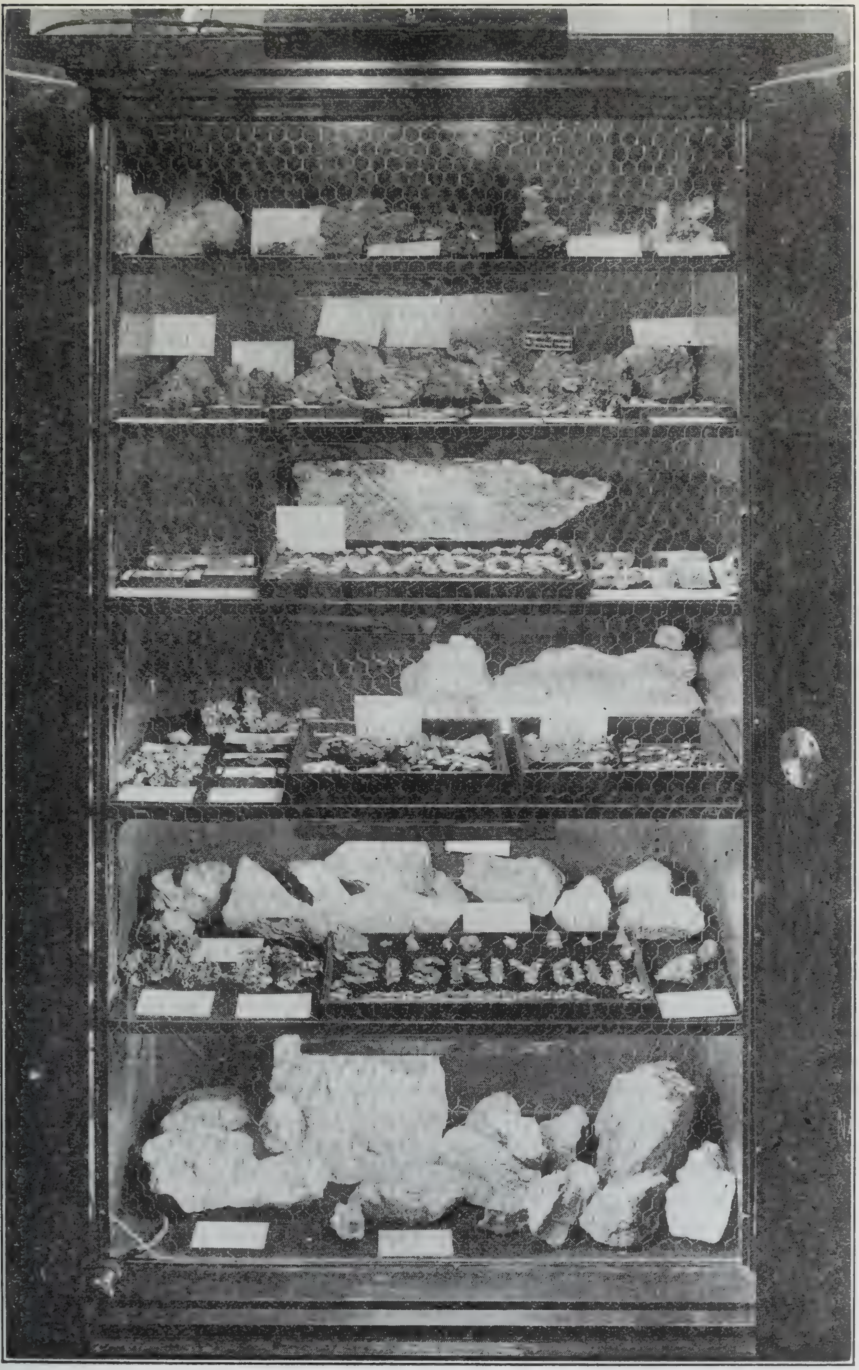
CALIFORNIA'S EXHIBIT AT THE AMERICAN MINING CONGRESS EXPOSITION, CHICAGO, ILLINOIS, OCTOBER 17-22, 1921.

By WALTER W. BRADLEY.

In connection with the convention of the American Mining Congress in the Coliseum at Chicago, October 17–22 last, there was held an Exposition of Mines and Mining. The sessions of the congress were held in the assembly room on the second floor of the annex, while the exhibits of machinery, appliances, and minerals occupied the entire ground floor of both the main Coliseum and annex.

There were instructive displays of many and varied kinds dealing with the mining, transportation and treatment of ores, both metallic and nonmetallic. Coal mining, however, was represented in greater proportion than the other branches, doubtless due to the proximity of the important coal districts of the United States. In the center of the main floor, space was reserved for exhibits by states and other governmental departments. Besides California, the following were represented: Alaska, Colorado, Republic of Mexico, Utah, University of Illinois, U. S. Bureau of Mines, U. S. Forest Service, U. S. Geological Survey, Lake Superior Iron District. The following is a brief description of their more important items. The Alaskan exhibit contained framed pictures of many Alaskan views, ore samples, and also displays of agricultural and fishery products as well. One feature of their exhibit was a miner with gold-pan and tub panning gold from sand brought from the beach at Nome. Colorado's feature was her display of radium ores and products, the latter being shown in a dark-room especially built for the purpose. In addition there were cases of mineral specimens showing Colorado's important ores, and one with a display of clay products. Mexico sent a creditable display of ores and minerals from widely distributed parts of the republic. The Assistant Secretary of the Interior was in attendance at the congress, and President Obregon's favorite band also came, and entertained the delegates with excellent renditions of several favorite Spanish and operatic airs. The Utah exhibit consisted mainly of colored panoramas and pictures, with some mineral specimens. The display of the Lake Superior Iron District included a model, carved in wood, of one of the large, open-pit iron mines, showing the geological structure.

California's exhibit was advantageously located partly in front of and immediately to the left of the main entrance to the Coliseum. With more than 50 different ores and minerals produced commercially by a total of 58 counties, it was not an easy task to decide on the number and kind of specimens to send and the nature of the display that would adequately represent to the visitors at Chicago the many resources of this truly wonderful state. Because of California's reputation as the 'Golden State' and the fact that she still leads all other states in output of the yellow metal, because the sight of gold is always attractive to the human eye whether trained or untrained, and because the subject of assistance to the gold miner was to receive attention at the congress sessions, it was decided to place that metal foremost in the exhibit.



California's Gold Exhibit in safe at American Mining Congress, Chicago.
Photo by Kaufman and Fabry Co.

The outstanding feature, therefore, and the one which did actually create the most attraction and comment was a steel safe, faced with plate glass, containing gold nuggets, gold dust, and free gold in quartz, of a total bullion value of at least $25,000. The specimen value of much of the material shown was several times the bullion value. This display was made possible by the generosity and coöperation of not only a number of California's operators who donated the funds to finance the exhibit, but also to those individuals and companies who entrusted to the State Mining Bureau some of their treasured and valuable specimens for the purpose. The Bureau wishes to here give due acknowledgment to the following who contributed to the fund: Carson Hill Gold Mines, California Rand Silver, Inc., Pacific Gas and Electric Company, California Metal and Mineral Producers Association, Empire Mines, Marysville Dredging Company, Shell Company of California, Idaho Maryland Mines Company, Valdor Dredging Company, Yuba Development Company, Fremont Mine, Engels Copper Mining Company, Pacific Coast Borax Company, Sierra Magnesite Company, Inyo Talc Company, and Western Rock Products Company.

Acknowledgment of appreciation is also due the following for the loan of valuable specimens without which the display could not have been made: Siskiyou County Board of Supervisors; Placer County Board of Supervisors; J. W. Preston, Jr., for K. D. Winship Estate, Amador County; Double O Mining Company, Placer County; North Star Mines Company, Nevada County; Mrs. Sadie Howe, Tuolumne County; Argonaut Mining Company, Amador County; Walsh Bros., Placer County; Scott Valley Bank, Siskiyou County; California Rand Silver, Inc., San Bernardino County; Burton and De Nure, Siskiyou County; Fred Grotefend, Shasta County; W. P. Hammon, Yuba County; Tillotson Mining Company, Placer County; Montacali Mines Syndicate, Calaveras County; Oro Fina Mine, Placer County; Grit Gold Mine, El Dorado County; Table Rock Mining Company, Sierra County; Golden Center Mine, Nevada County; Georgia Hill Gold Mining Company, El Dorado County; H. H. Sherrard, Manager, Tuolumne County Exhibit; George C. Noonan, Siskiyou County; Fippen and Hayden, Siskiyou County; Carson Hill Gold Mines, Inc., Calaveras County; Errol MacBoyle, Nevada County; Orman Lutz, Mariposa County; Pacific Asbestos Corporation, Calaveras County; Engels Copper Mining Company, Plumas County. Especial mention is due the Siskiyou County Board of Supervisors for their sending in its entirety the excellent collection owned by that county, consisting of gold-quartz specimens and nuggets, which has taken prizes at several expositions and fairs and has a bullion value of approximately $15,000. Thanks are also due to the Geo. W. Hunt Company, agents for the National Safe Company, Cleveland, Ohio, for the loan of the safe in which the gold was displayed.

The safe was lighted within by tubular, electric, show-case lamps, and wired plate-glass (instead of plain plate) was used in front of the shelves as an added safeguard against any attempt that might be made to break in. The specimens were arranged on five shelves. In case of two samples (Amador and Siskiyou) small-size placer gold was arranged in the form of the letters spelling the name of the county from which the metal had come. Included in the Siskiyou collection was a single placer nugget worth $550. Besides placer gold, the display included several beautifully crystallized specimens of lode gold, some of which induced particular comment. Specimens of platinum, diamonds, and other California gem stones were also shown. Several of the best specimens from the permanent collection in the State Mining Bureau museum were included.

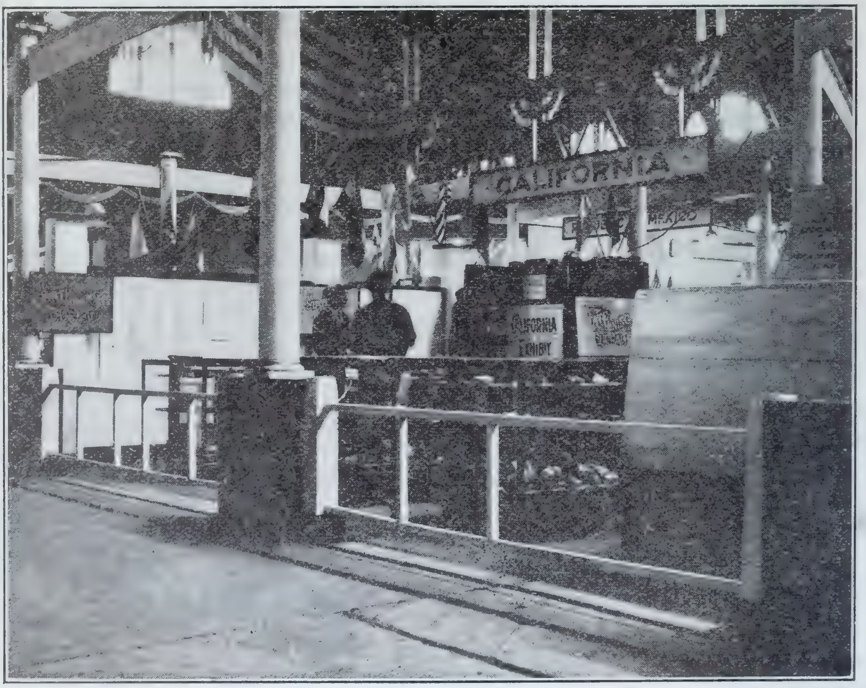
In addition to the real gold displayed in the safe, facsimiles were shown of some of California's famous nuggets, facsimile bars representing the average monthly bullion clean-up ($100,000) of the Carson Hill Gold Mines, Inc., and a large, gilded, wooden model representing the average annual gold yield of California for the 72 years, 1849–1920 inclusive. The total for the 72 years was $1,720,218,101, and the average $23,891,918, being the equivalent of 65.8 cubic feet in volume and 39.5 tons, avoirdupois, in weight. Photographs of one of the large gold dredges of the Yuba Consolidated Goldfields Company were hung on the wall, likewise pictures of bullion bars representing a week's clean-up from one and from eight dredges.

California's petroleum resources were represented by panoramic photographs of the principal oil fields, and by charts giving production data, one of which showed the comparative yield of other states illustrated by means of proportionately-drawn derricks.

The remainder of the floor space allotted to California was utilized by eight glass show-cases, with three shelves each, in which were displayed nearly 400 specimens representing the many ores, metallic and nonmetallic, that are found in this remarkably resourceful state. They were arranged in definite order according to substances. A few of these specimens were especially donated for the purpose of this exposition; but most of them were selected from the permanent collection in the museum of the State Mining Bureau.

From the many favorable comments made and the interest shown by the continuous stream of visitors in front of the gold safe and circulating through the exhibit, it is felt that the effect was well worth while, and that California's resources were attractively presented to many thousands who might otherwise have been unaware of them.

California's Mineral Exhibit at American Mining Congress, Chicago. Gold Safe in center; Mineral Cases in foreground; Model Gold Bar at left.



Part of California's Mineral Exhibit at American Mining Congress, Chicago. Oil Production Charts at left; Mineral Cases in center; Model Gold Bar at right.

GENERA OF DIATOMS CHARACTERISTIC OF MARINE AND FRESH WATERS.

By G. Dallas Hanna[1] and William M. Grant.

Diatoms are unicellular, microscopical plants which appear to have suddenly sprung into existence near the beginning of the Tertiary period. They are world wide in their present distribution and occur in almost incredible abundance under favorable circumstances. The largest species are barely visible to the unaided eye, yet when examined under the microscope they display some of the most gorgeous beauties of nature. They have skeletons of pure, amorphous silica which is secreted in most perfect geometrical designs. Because of this delicacy of form and the consummate skill required in the proper examination of them they have long been the playthings of microscopists.

Also because of their composition and their abundance they are among the most important builders of organic deposits which are known in geology. Probably they far exceed any other group of plants or animals in the bulk of the sediments which they produce, not even excepting the much heralded coral. Some diatom deposits in California are 6000 feet thick, practically pure silicious remains all the way. And in some large lakes the organisms live so abundantly that the bottoms are covered to an unknown depth.

In the present ecology of the sea the diatom holds the important position of being the foundation upon which all other living things must depend. They are the transformers of inorganic matter into pulsating protoplasm.

Of late years geologists have come to recognize that the Tertiary diatoms are the chief source of the great oil fields of California. Many facts have been brought to light to strengthen this theory since it was first brought to the attention of the world. Not the least important of these has been an analysis of oil which was extracted from living diatoms by Dr. Albert Mann of the Carnegie Institution of Washington. The results of this have not as yet been published but he has stated that in its properties the oil seems more like that derived from an animal source than a vegetable, still it comes closer to petroleum than any other oil known to man.

Besides the above important roles filled by diatoms a few of the economic uses to which they are put may be mentioned briefly.

As abrasives in various polishes they have long been used. Silver polish, many hand and scouring soaps, toothpastes and powders owe their existence to the diatoms which they contain. Large quantities are used in filters for the refining of sugar but perhaps the greatest quantities are used (1) in dynamite to hold and dilute the nitroglycerine and, (2) mixed with magnesia and asbestos in the manufacture of heat resisting furnaces and insulators.

Not all diatoms are suitable for all of the above purposes. The heavy marine forms make the best insulators while the smallest, purest fresh-water species are best for toothpastes. This brings up the question which is very often asked by geologists, ''Can freshwater and marine forms be distinguished and if so, how?'' It is in order to answer this query that the present paper has been prepared.

---

[1] Curator, Dept. of Invertebrate Paleontology, California Academy of Science, San Francisco, California.

DIATOM DEPOSITS.

The diatoms of most *direct* economic importance to man are the fossils which have been deposited, preserved and elevated above the surface of the water in many places. They have been found in varying degrees of purity and widely distributed. When the beds are composed of diatoms only, they are pure white and the material is very light in weight for its bulk. Pure diatomaceous earth however is not very common. More often it is mixed with more or less clay or other foreign material. This changes the color to buff, gray, green, blue or red and sometimes the deposits are black due to impregnation with petroleum. Almost all Tertiary shales, clays and marls contain greater or less percentages of diatoms. In California, those which are particularly rich belong to the 'Monterey' series, or the middle miocene.

Not all material, however, which is light in color and weight and is silicious is diatomaceous earth. Amorphous silica and volcanic ash are substances commonly mistaken therefor. It must be emphasized that the only sure way to determine the character of a deposit is by an examination with a compound microscope. Hand lenses and binoculars do not have sufficiently high magnification for this purpose. Cheap instruments can be used in the field but for the refined study of these organisms the best equipment in existence is none too good. In fact the test of excellence of microscopes for a great many years has been made by the examination of certain delicate species of diatoms.

Over 8000 species of diatoms have been named. More than half of this large number have been fossilized. For the most part they are described in rare, foreign publications which are wholly inaccessible to the average worker. Many species have been described from the California deposits but there is not a single complete copy of the publication which contains most of them in any west coast library to our knowledge.

It is not only possible to tell whether a given deposit has been laid down in freshwater or in salt water but it can be determined with fair certainty if it was brackish. Not only this, if the deposit is marine it is possible to determine something of the depth of the water at that locality at the time. Bottom living species can not exist below the line of light because this they must have for the formation of the chlorophyl which distinguishes them from animals. If the bottom species are absent and the deposit is made of pelagic forms we know the water there was deep.

The uses to which diatoms could be put in the following of strata and the determination of the ages of rocks can not be stated. Sufficient work has not been done on a single deposit for use in comparison. Many species, however, are of very wide distribution at the present time so that if the same condition has prevailed in the past they should be excellent horizon markers. The difficulty in the use of mollusks for this purpose has been the fact that single species were not of sufficient geographical distribution to enable one to correlate distant deposits, one with another. It is hoped that the intensive study of the microscopical organisms, particularly the diatoms, radiolarians and foraminifers will aid in overcoming this obstacle.

There are some genera of diatoms which are found both in salt water and in fresh water, some are exclusively freshwater in habitat and a great many are marine. One genus is almost always associated with brackish waters. As a broad rough classification, long spindle-shaped diatoms indicate freshwater while circular ones indicate marine conditions. This is not entirely true, however, and an examination of genera should be made in every case. There are some circular freshwater diatoms and some long slender saltwater ones.

NOMENCLATURE.

The diatom skeleton is usually called a *frustule.* This is normally composed of three parts which are put together like a pill box. The top and bottom are called *valves* and the ring or hoop between them is called a *girdle.* When a form is seen on edge it appears rectangular whether it is circular or long and slender in valve view. The characteristic markings appear on the face of the valves, except in some species which grow in long cylindrical form.

Many species grow individually and multiply by a simple division of the frustule at the girdle. Others, however, grow in chains and are attached to each other by various kinds of horns or processes.

The names of genera and their respective values have been adopted from the well known work by Henri Van Heurck, 'A Treatise on the Diatomacae.' Also many of the text figures have been copied from that publication.

We are under deep obligation to Dr. Albert Mann of the Carnegie Institution for assistance in identifying the diatoms which are illustrated on the plates.

ARRANGEMENT.

In the following account all genera which are confined to fresh waters are grouped together. Those which are found in brackish water form the next group and they are followed by the large number of strictly marine genera. Finally a few genera which are found in all waters and are encountered in almost every gathering are placed at the end. We believe that this arrangement will prove more useful to the working geologist than a strictly systematic one. If the latter were adopted confusion might result from the fact that some genera confined to fresh waters are biologically very closely related to others which live exclusively in the sea. The character of the habitat has not caused a sharp demarcation in the evolution of the various groups of diatoms such as we find among mollusks.

Freshwater genera.

Cymbella Agardh, plate I, figure 2; plate IV, figure 2.

Valve cymbiform, the raphe and central nodule being near the center. Sometimes a stauros is developed about the central nodule. Raphe generally very heavy.

Surface marked with lines of beads which slightly radiate from the center. Raphe forming an angle at the central nodule and the terminations situated at the apex of each end.

This freshwater genus is widely distributed. It is distinguished from *Amphora* by the position of the raphe and central nodule, and from *Navicula* by the excentric shape of the valve.

Encyonema Kützing, figure 1.

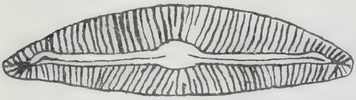


FIG. 1. *Encyonema prostratum* Ralfs. Freshwater.

Valve somewhat cymbiform but with the raphe straight, not forming an angle at the central nodule. Also the terminations of the raphe are distant somewhat from the ends of the valve. The markings are more or less heavy lines or rows of beads on each side of the raphe.

A common freshwater genus of wide distribution.

Surirella Turpin, figure 2.

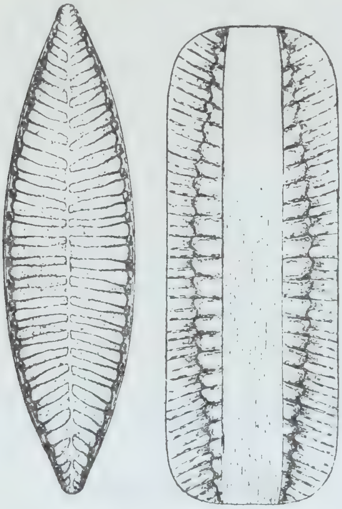


FIG. 2. *Surirella biseriata* Brebison. Freshwater.

Valve oval or spindle shaped, usually flat but sometimes twisted. Marked with heavy flattened ribs which may extend to the center from each side or they may only extend part way from the margins.

This genus is almost exclusively freshwater in its habitat and many beautiful species are known.

Amphipleura Kützing, figure 3.

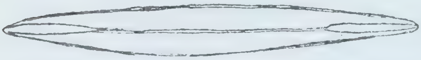


FIG. 3. *Amphipleura pellucida* Kützing. Freshwater.

Valve narrowly lanceolate with a raphe in the center but no central nodule. The nodules at the ends of the raphe are much elongated. The surface appears smooth and hyaline with all ordinary microscopes. Under the most favorable conditions, however, it is possible to see that it is covered with delicate beading. On account of the perfection which optical equipment must attain for this resolution, *Amphipleura* has long been one of the best objects for the rigid test of microscopes. The genus has but few species all of which are confined to fresh waters.

Gomphonema Agardh, figure 4.

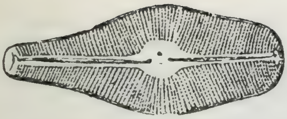


FIG. 4. *Gomphonema geminatum* Lynberg. Freshwater.

Valve longer than wide but with one apex narrower than the other. There is a median raphe and central nodule. The markings consist of radiating lines of beads.

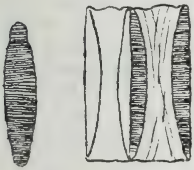
The species of this genus are almost exclusively freshwater in habitat. They are related to *Navicula.*

Epithemia Brebison, plate II, figure 3.

Valves alike, arcuate in shape, without a raphe or central nodule. Surface sculptured internally with coarse striæ and externally with lines of beads which radiate slightly from the concave margin.

The species of this genus are almost exclusively fresh water in habitat. In certain California deposits of fossils they are very abundant.

Fragilaria Lyngbye, figure 5.



Valves symmetrical, without raphe or nodules. Marked with fine transverse striæ, but without ribs or beads. The rectangular frustules are united in long filaments. A hyaline space is sometimes seen in the usual position of the raphe.

The species of this genus are so nearly all characteristic of fresh water that for practical purposes they may be classed with the flora of that habitat.

FIG. 5. *Fragilaria virescens* Ralfs. Freshwater.

Diatoma De Candolle, figure 6.

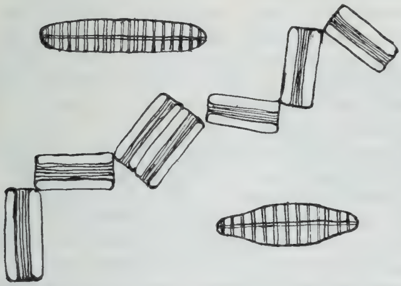


FIG. 6. *Diatoma vulgare* Bory. Freshwater.

Valves spindle shaped or lanceolate, with rather distant transverse bars and an indistinct median hyaline line. Frustules quadrangular in girdle view and united in life in long chains, the individuals attached cornerwise.

The species of this genus live in fresh water and are widely distributed and common.

Eunotia Ehrenberg, figure 7.

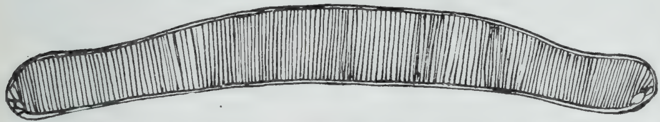


FIG. 7. *Eunotia major* (Ehrenberg). Freshwater. Other species are marine. (?)

Valve arcuate, linear, rounded on the ends. No raphe or nodules. Surface sculptured with transverse striæ but no coarse ribs. In girdle view the frustules are united to form a rectangular mass.

All of the many species of *Eunotia* appear to live or to have lived in fresh waters.

Stictodiscus Ehrenberg, plate III, figure 1.

Valves circular with radiating, close set lines of beads; these become sparse or absent near the central area. Around the border there are numerous evenly spaced spines. In vertical view these appear as dark spots on account of the upper portions being out of focus.

The few species of this genus are occasionally found in abundance in fresh waters. A particularly rich deposit is found near Klamath Falls, Oregon, where the example illustrated was obtained. The genus bears close similarity to some marine groups such as *Coscinodiscus* but can be distinguished by a careful examination of the border spines.

Brackish water genera.

Mastogloia Thwaites, figure 8.

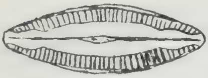


FIG. 8. *Mastogloia lanceolata* Thwaites. Brackish water.

Valve naviculoid, spindle shaped, with a row of siliceous plates on the outer margins.

This genus is almost always found in brackish water. Except under high powers it is not readily distinguished from *Navicula* and would ordinarily be taken for one of that group.

Pleurosigma W. Smith, plate IV, figure 1.

Frustules more or less elongated and sigmoid. A raphe extends through the center of the valve and has a central nodule. Surface sculptured with striæ which cross each other at 60° or more. These markings are difficult to see with low powers or uncorrected lenses and for a long time one species, *P. angulatum*, was used as a test object for microscopes.

Marine genera.

Amphora Ehrenberg, figure 9.

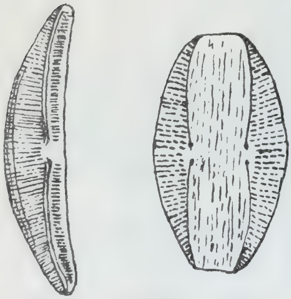


FIG. 9. *Amphora ovalis* Kützing. Chiefly marine.

Frustules generally oval or oblong with the girdle or central band hyaline, or marked with faint longitudinal lines. Valves cymbiform, with the central nodule near or at the concave margin and often surrounded by a hyaline area called a stauros. The raphe is heavy and curved to conform with the valve. The markings on the valves consist of lines of beads which slightly radiate from the central area.

Amphora is a group chiefly confined to marine waters. A few species may be found in brackish water and under exceptional circumstances it may be seen in fresh water. It is so predominately marine, however, that its presence, in the absence of other information, may be taken as conclusive proof of the marine origin of a particular fossil deposit which may be examined. It is world wide in distribution and over 200 species have been placed in it. It is not apt to be confused with any other genus except *Cymbella* of fresh water. That group, however, has the central nodule and hyaline area not at one side of the valve but nearer the center.

Rhabdonema Kützing, figure 10.

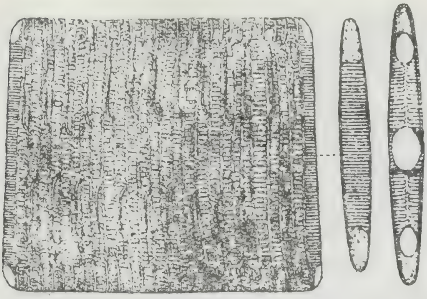


FIG. 10. *Rhabdonema adriaticum* Kützing. Marine.

Frustules forming filaments. Valves oval or spindle shaped, with a hyaline space at each end and through the middle as a narrow line. Markings consist of transverse ribs which bear heavy beads.

The genus is exclusively marine and should not be confused with some similarly shaped genera of freshwater diatoms.

Campylodiscus Ehrenberg, figure 11.

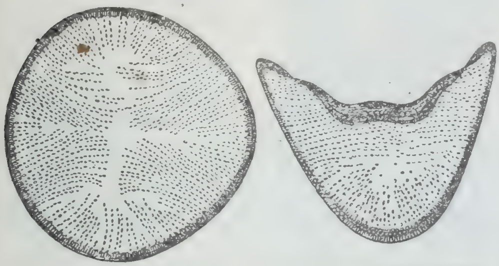


FIG. 11. *Campylodiscus echeneis* Ehrenberg. Marine.

Valves circular but much curved horizontally, saddle shaped, with a larger or smaller hyaline space in the center. Marked with coarse ribbing, beads and lines.

About 90 species have been placed in this genus and almost all of them are marine forms. A few have been found in fresh water but they are not abundant there. Its presence in a deposit may be taken as almost positive evidence of the marine origin thereof.

Raphoneis Ehrenberg, figure 12.

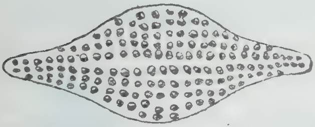


FIG. 12. *Raphoneis amphiceros* Ehrenberg. Marine.

Valves lanceolate or spindle shaped. Marked with a hyaline space through the center longitudinally but without raphe or nodules. Surface beaded, the beads in transverse, slightly radiating rows.

The great modification of shape and variation of sculpture of the members of this genus have lead to the designation of many nominal species, all of which are marine.

Entopyla Ehrenberg, figure 13.

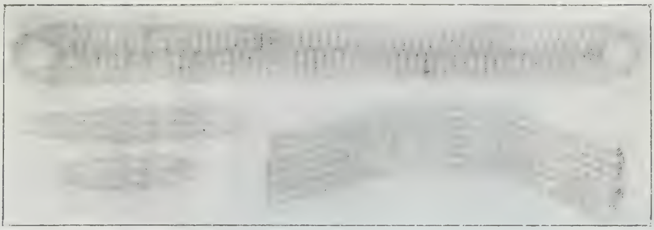


FIG. 13. *Entopyla australis* Ehrenberg. Marine.

Valves long and slender, very much curved longitudinally. The concave valve has large terminal nodules and heavy transverse bars which reach only to the median line from each side. The convex valve is similar but lacks the terminal nodules. In girdle view the frustule has internal septa.

The few species of the genus are exclusively marine.

Gephyria Arnott, figure 14.

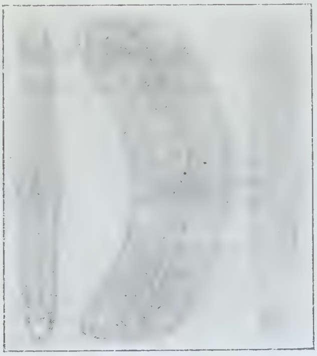


FIG. 14. *Gephyria media* Arnott. Marine.

The genus is very closely related to *Entopyla*. It has dissimilar valves and the same shape but it lacks the internal septa and usually the transverse markings are finer.

The six species are marine.

Licmophora Agardh, figure 15.

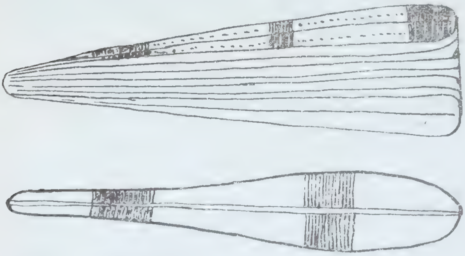


FIG. 15. *Licmophora gracilis* (Ehrenberg). Marine.

Valves linear or cuneate in shape with a hyaline narrow line centrally. Marked transversely with fine striæ. Frustule triangular in shape, with internal septa showing in girdle view.

The numerous species of this common genus are all marine.

Rhizosolenia Ehrenberg, figure 16.

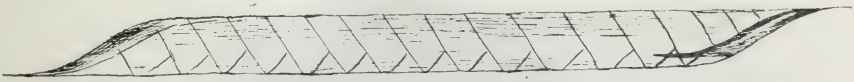


FIG. 16. *Rhizosolenia styloformis* Brightwell. Marine.

Frustules long and slender, sharply pointed at each end, approximately circular in cross section. Composed of numerous imbricate or annulate plates which are clear and transparent in most cases.

The members of this genus are marine and pelagic in habitat. There are between thirty and forty species known On account of their delicacy they are not well preserved as fossils as a rule.

Chætoceros Ehrenberg, figure 17.

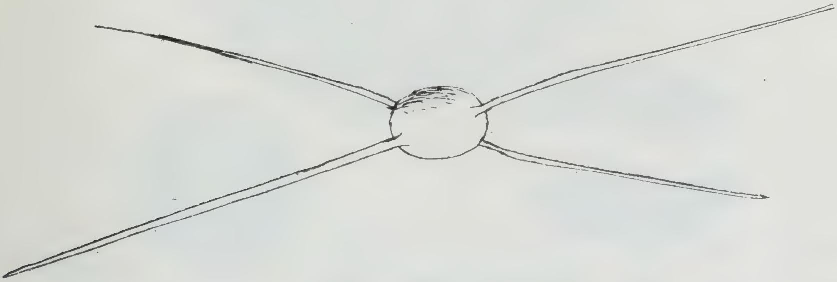


FIG. 17. *Chætoceros wighamii* Brightwell. Marine.

Frustules circular or elliptical, unmarked, usually united in long chains by means of interlocking horns.

Like the last, the species of this genus are pelagic and marine in habitat. Great variation is displayed, even in the same chain of individuals. The terminal member of each chain is usually greatly modified and looks very unlike the remainder. In it the horns are heavily developed and barbed.

Isthmia Agardh, plate I, figure 3.

Frustule trapezoidal, flattened, with a broad girdle around the center. The girdle and both valves are strongly sculptured with flattened beads.

The few species of this genus are widely distributed and very common on our sea coast. It is entirely unlike any other group, found either in fresh or salt water.

Bidulphia Gray, figures 18, 19.

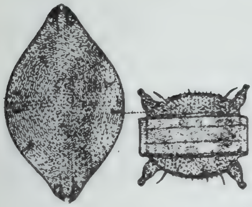


FIG. 18. *Bidulphia rhombus* Ehrenberg. Marine.

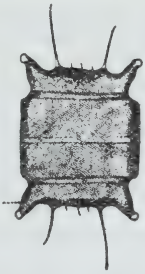


FIG. 19. *Bidulphia granulata* Roper. Marine.

Frustule irregularly quadrangular in girdle view, oval in cross section, ornamented with four or more large blunt horns; often also with a few spines. Surface variously sculptured with hexagons or beads.

The above applies to *Bidulphia* proper. Several other groups, long recognized as distinct genera have been united with it. The most important among these is *Triceratium* which is common in all oceans and many deposits of fossils. (Plate I, figure 1.)

Several hundred species have been recognized in the various subgenera of *Bidulphia*, all of which are marine in habitat. It would be difficult to find a deposit of marine diatoms without some species of *Bidulphia* or *Coscinidiscus*.

Eupodiscus Ehrenberg, figure 20.

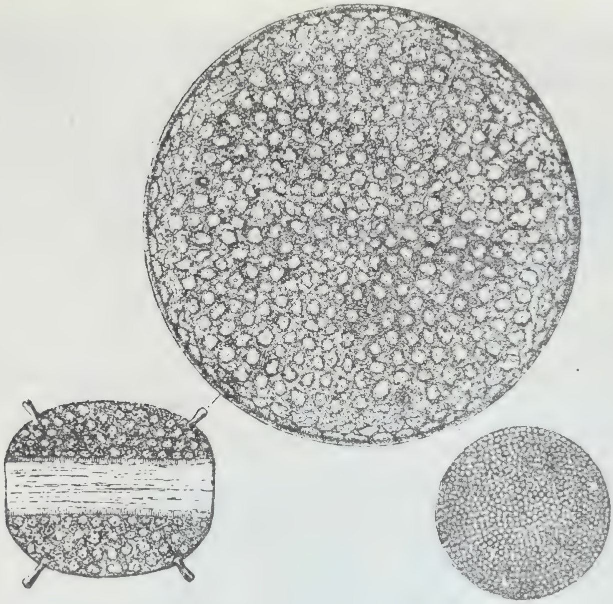


FIG. 20. *Eupodiscus argus* Ehrenberg. Marine.

Valves circular, slightly convex exteriorly. Sculptured with one to four strong spines which are blunt on the ends. The surface also is marked by numerous irregular cells or beads.

Eupodiscus is an exclusively marine genus but it not common on the Pacific Coast of the United States if it is found at all. The species are heavy and massive and consequently sink faster during the preparation of the gatherings than most other diatoms. For this reason, when decanting light material they should be looked for among the larger sand grains which rapidly settle.

Aulacodiscus Ehrenberg, plate III, figure 2.

Valves circular marked with beads which are usually arranged in radial and concentric form. Margin ornamented with numerous high blunt spines between which the silica is somewhat scalloped, thus making these diatoms some of the most beautiful which are known.

This genus consists of several species all of which are marine. One, *A. oregonus* is very common on the west coast both as a fossil and living.

Actinoptychus Ehrenberg, plate III, figures 3, 4.

Valves circular divided into six or more segments. Each segment is in a different plane from those adjoining which makes it impossible to have the entire surface in perfect focus at one time. The surface of the segments is irregularly marked with beads or cross hatched lines. The central area is hyaline. A border is usually developed which is wide and heavy.

The species of this genus are exclusively marine in habitat.

Asterolampra Ehrenberg, figure 21.

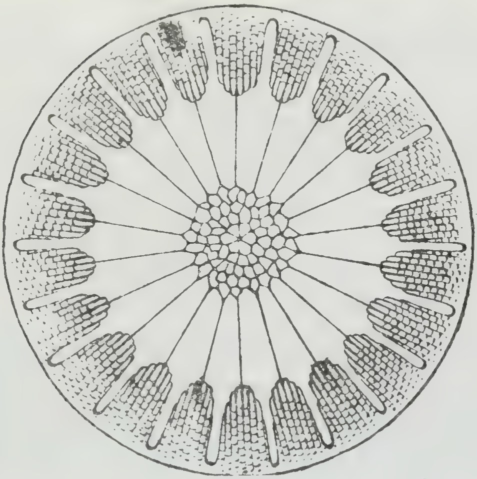


Fig. 21. *Asterolampra exima* Greville. Marine.

Valve circular with numerous radiating rays of heavy hyaline silica. The interspaces are marked with cross hatched lines.

The species are exclusively marine, and many of them are known only as fossils.

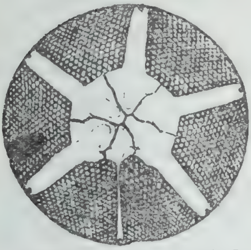


Fig. 22. *Asteromphalus hookeri* (Ehrenberg). Marine.

Asteromphalus Ehrenberg, figure 22.

This genus is similar to *Asterolampra* but the center is somewhat asymmetrical. One of the radiating ribs of silica is longer than the others and less massive.

Several species are known, all marine and usually very widely distributed.

Arachnoidiscus Ehrenberg, plate II, figures 1, 4.

Valve circular divided into segments by bars of silica. Also the surface is marked with raised flat beads which are arranged in concentric rows. The margin is variously marked with scallops or loops.

Individuals of this genus are abundant on the California Coast and in many of the marine deposits of fossils. Only a few species are known and they are all marine. It is one of the most beautiful organisms in nature and it gets its name from its general resemblance to the web of a spider.

Coscinodiscus Ehrenberg, plate V, figures 1, 2, 3, 4.

Valves circular, rarely elliptical, slightly convex in the center. Surface marked with cells or beads which may be sparse or closely arranged. Almost endless variation is found in the markings, but spines are not developed. In this respect the genus differs from other circular forms.

The number of species in the genus is very large and all of them are marine. So numerous are they that scarcely a marine gathering of diatoms, either fossil or recent, pelagic or bottom, can be made without getting them in some quantity. And often it is possible to secure them in almost any quantity with scarcely any other forms being present. At times large patches of the North Pacific Ocean, miles in extent, become colored brown on account of the abundance of *Coscinodiscus* in the water.

Actinocyclus Ehrenberg, plate I, figure 4.

Valves circular, slightly convex in the center, variously sculptured with cells or beads which are arranged in radiating rows. The genus is like *Coscinodiscus* in all essential respects except that near the margin on one side there is a small hyaline area or nodule. Sometimes the margin is ornamented with a series of low spines.

Actinocyclus is exclusively marine like *Coscinodiscus* but the number of species is far less.

Cosmopolitan genera.

Stauroneis Ehrenberg, plate IV, figure 3.

Frustule spindle shaped with a raphe in the center. The central nodule is spread out entirely across the valve so as to produce a broad hyaline band, the cross, from which the genus takes its name. The surface otherwise is marked with numerous rows of fine beads, which under low powers appear as lines.

The genus is closely related to *Navicula* and like it, is found both in fresh and salt water. It is illustrated here because some of the species are abundant and world wide in distribution.

Navicula Bory, plate IV, figures 4, 5, 6.

Frustules spindle shaped or oval with a central raphe which is straight. Surface variously marked with transverse rows of beads or striæ.

About 1,500 species have been described in this genus. Many of them are of wide distribution and some are of freshwater, others of marine habitat. Naturally among so many species there is very great variation in shape and sculpture but all attempts to divide the group into other genera have failed. Of the species illustrated *N. distans* is a common freshwater type while *N. dilatata* conforms to the are constricted in the middle. *Navicula* has been truly called the cosmopolitan diatom.

Cocconeis Ehrenberg, plate II, figure 2; plate IV, figures 7, 8.

Frustule oval in shape with the upper and lower valves unlike. The upper valve does not have a true raphe, or central and terminal nodules. The lower valve, however, is thus provided. The markings consist of more or less radiating lines of beads.

The genus is both marine and freshwater in habitat and is introduced here because of its general similarity to some strictly marine genera. The student is warned not to confound it with the oval species of *Auliscus* or with a circular diatom which may have been tipped partly on edge under the microscope.

Synedra Ehrenberg, figure 23.

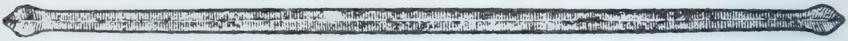


FIG. 23. *Synedra capitata* Ehrenberg. Freshwater? Other species are marine.

Valves very much elongated, lanceolate, with a clear hyaline space down the center. Surface marked with transverse striæ.

A great many species are known in this genus and they are recognized by their very great length as compared with their breadth. In this respect they are comparable with no other genus considered herein except *Nitzschia,* the forms of which are asymmetrical.

The species of *Synedra* are confined for the most part to freshwater but there are some found in marine and brackish habitats. The genus is given here because it is often encountered.

Nitzschia Hassall, figure 24.

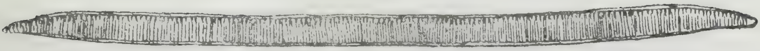


FIG. 24. *Nitzschia lanceolata* Thwaites. Marine? Other species are freshwater.

Valves usually long and slender, pointed bluntly at each end. One side of each valve is thickened and furnished with a series of short ribs. The remainder of the surface is furnished with various formations of lines and delicate punctations, for which a high power objective is required to study.

Nitzschia contains a great many species, some of which are found in freshwater, others in the ocean and still others in brackish water. It is shown here because it is met with so frequently in the examination of diatom gatherings.

Melosira Agardh, figures 25, 26.

Frustules united into a cylindrical chain and joined usually by small teeth which interlock. Each individual, when seen in side view, appears quadrangular in outline, but circular when seen in end view. In both cases the species are variously sculptured with protuberances, lines, and beads.

Some marine species of the genus are world wide in distribution. Some live in fresh water and the circular appearance of the valves when seen on end should not cause them to be confused with the numerous marine genera of circular diatoms. There is one species of *Melosira* which alone forms some very large deposits in California, Nevada, Idaho and Oregon. This is *Melosira granulata* and is illustrated because of the frequency with which it is seen in the freshwater lake deposits.

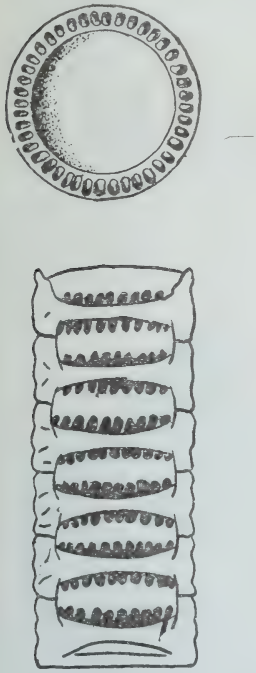


FIG. 25. *Melosira sulcata* Ehrenberg. Marine.

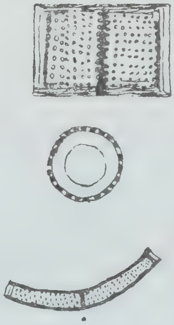


FIG. 26. *Melosira granulata* Ehrenberg. Freshwater.

Cyclotella Kützing, figure 27.

Valves circular, usually very small, and usually with a hyaline space in the center which is marked with fine dots. Outside the central area the valve is marked with radiating lines of various lengths and intensity.

The species of this genus are very commonly met with in fresh water, although some are marine in habitat. It is the only common circular diatom found in fresh water and can be distinguished from marine forms by the sculpture. The surface is not marked with a series of beads or cells such as is found in *Coscinodiscus.*

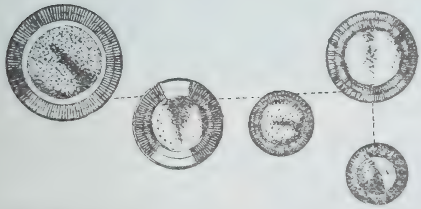


FIG. 27. *Cyclotella striata* Kützing. Freshwater. Other species are marine.

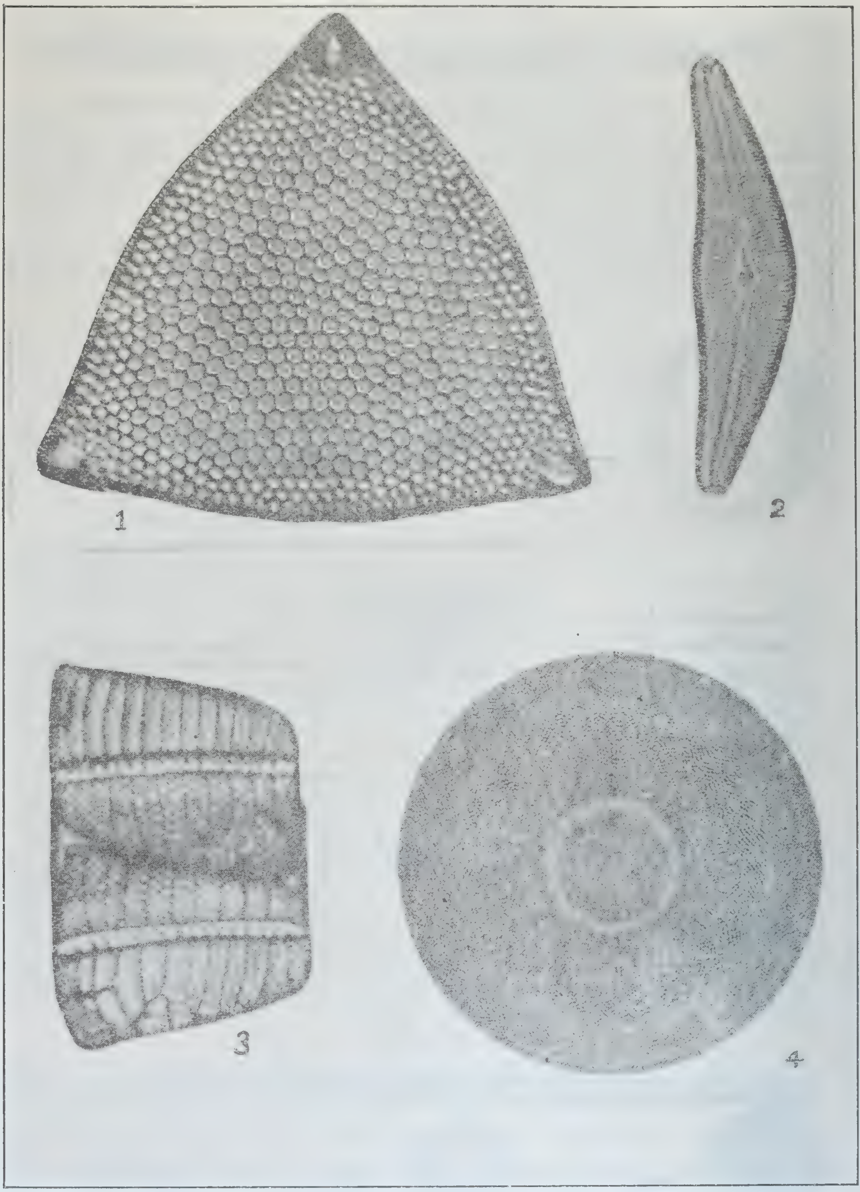


Plate I.

1. *Triceriatum broeckii* L. Fort. Marine.
2. *Cymbella lanceolata* (Agardh). Freshwater.
3. *Isthmia nervosa* Ehrenberg. Marine.
4. *Actinocyclus japonicus* Castracane. Marine.

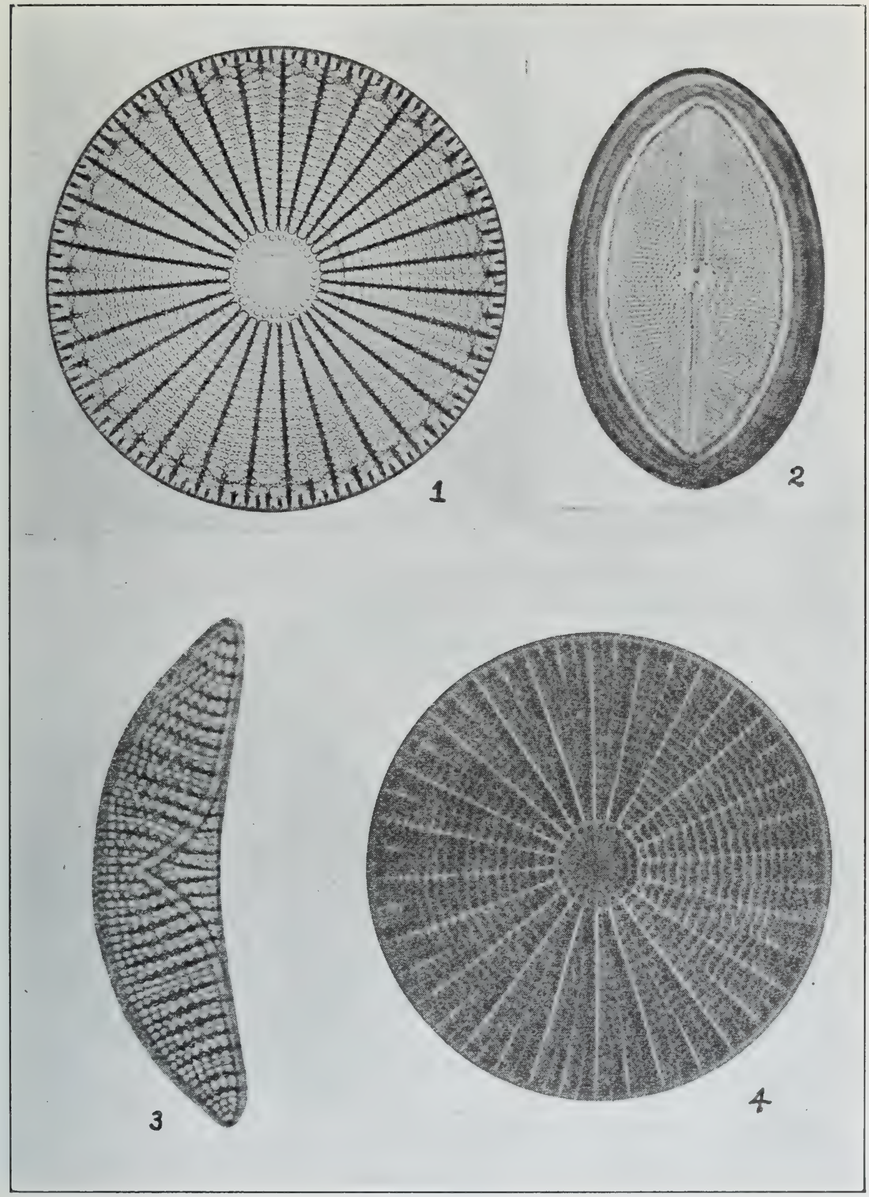


Plate II.

1. *Arachnoidiscus ehrenbergii* Bailey. Marine.
2. *Cocconeis placentula* Ehrenberg. This specimen is from a gathering of freshwater material. Other species of the genus are marine.
3. *Epithemia turgida* Kützing. Freshwater.
4. *Arachnoidiscus ehrenbergii* Bailey. Same specimen as figure 1. Photographed to show the structure of the valve.

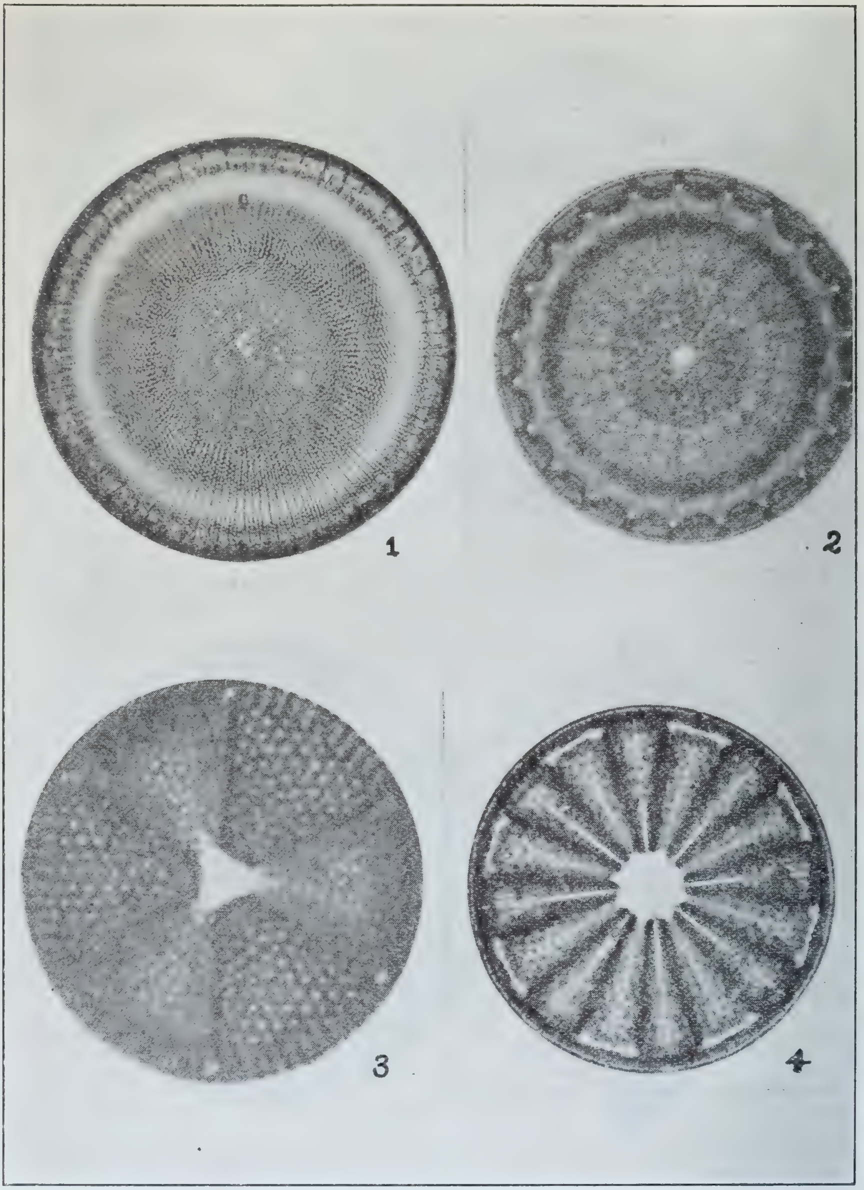


PLATE III.

1. *Stictodiscus niagaræ* Ehrenberg. The members of this genus live in fresh water and great care must be taken not to confuse them with *Coscinodiscus.* This specimen came from Klamath Falls, Oregon.
2. *Aulacodiscus oregonus* Harvey and Bailey. Marine. Very common on the west coast.
3. *Actinoptychus undulatus* (Bailey). Marine. This very common and exceedingly variable diatom is found in deposits supposed to be Oligocene in age and on up the scale to the present time.
4. *Actinoptychus splendens* (Shadbolt). Marine.

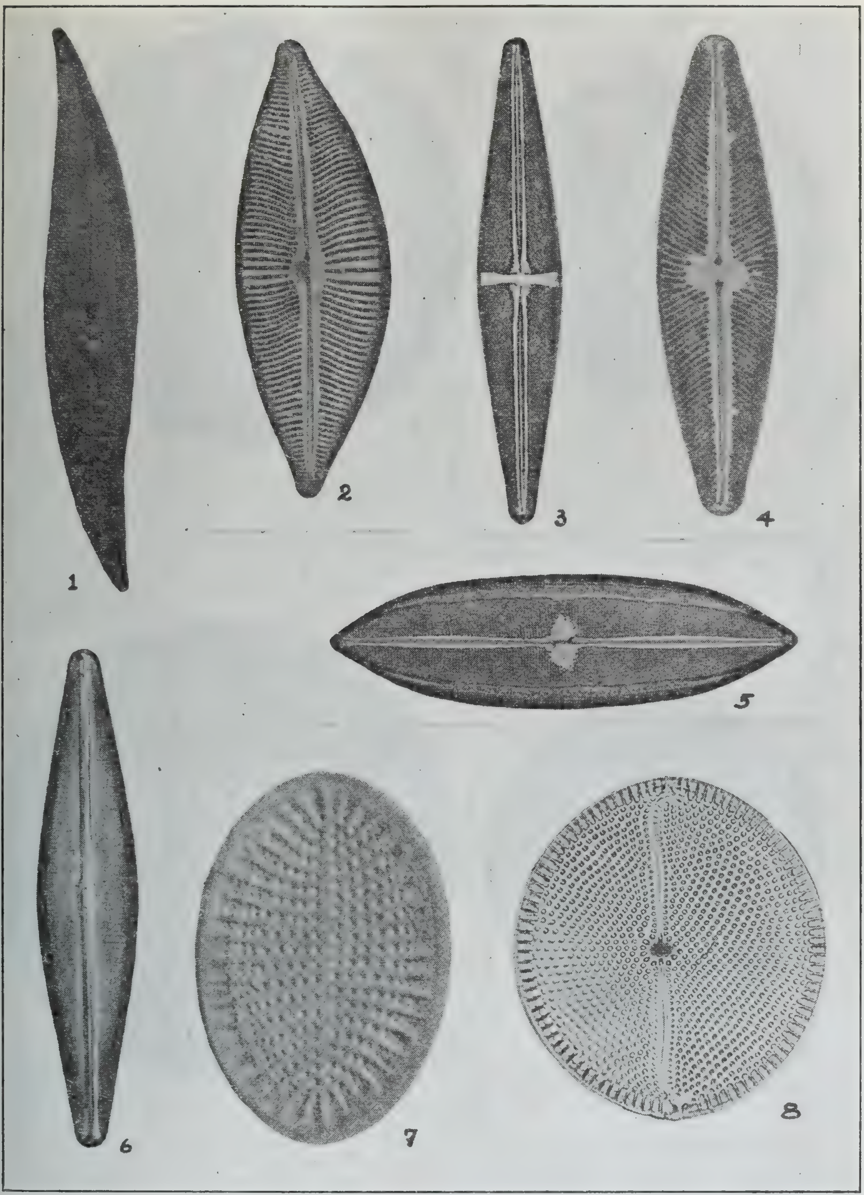


PLATE IV.

1. *Pleurosigma normanii* Ralfs. The genus lives almost exclusively in brackish water. This specimen came from Belvedere Island in San Francisco Bay.
2. *Cymbella ehrenbergii* Ralfs. Freshwater.
3. *Stauroneis phœnicentoron* (Nitzsch). Found both in fresh and marine waters.
4. *Navicula distans* (?) (W. Smith). Freshwater. This specimen came from a deposit near Klamath Falls, Oregon.
5. *Navicula dilatata* Ehrenberg. Marine.
6. *Navicula inelegans* Grove and Sturt. Marine.
7. *Cocconeis baldjikiana* Grunow. This species is marine. A few others inhabit fresh waters.
8. *Cocconeis splendida* Gregory. Marine.

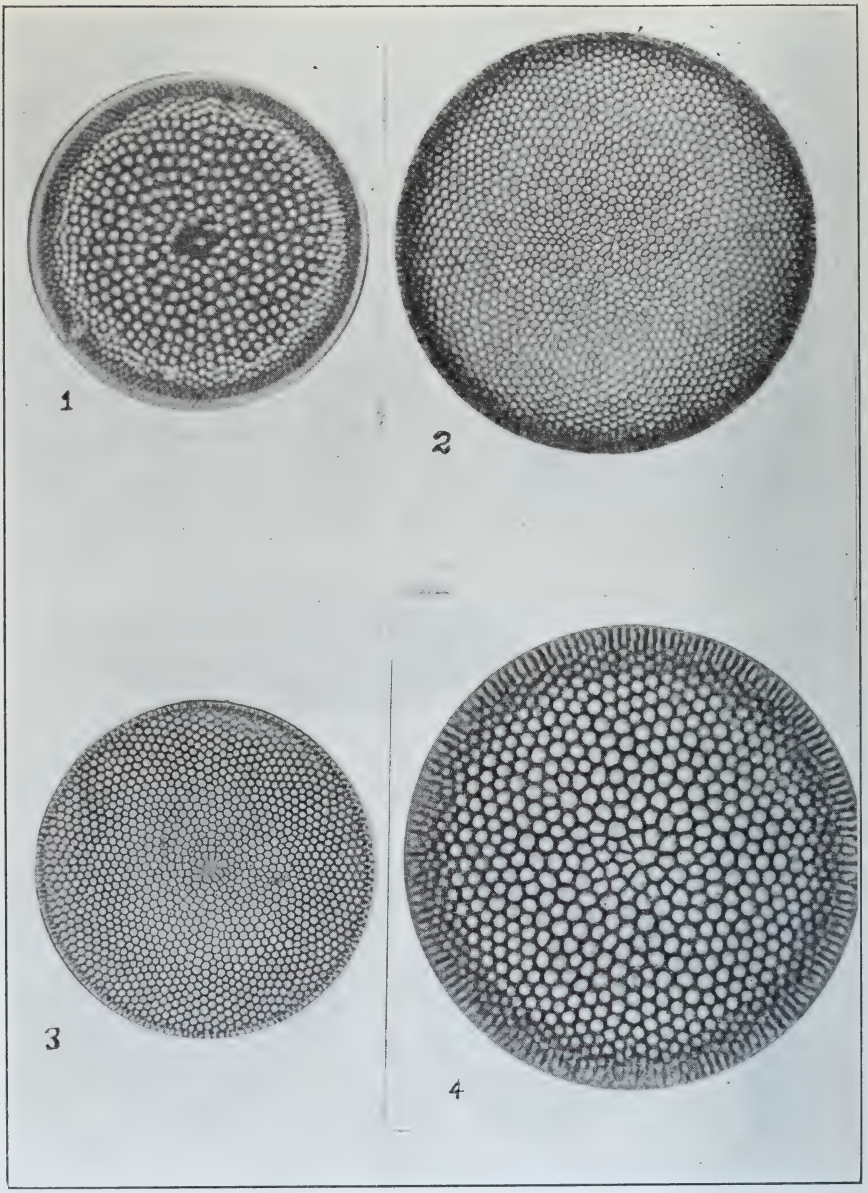


Plate V.

1. *Coscinodiscus velatus* A. Schmidt.
2. *Coscinodiscus marginatus* Ehrenberg.
3. *Coscinodiscus asteromphalus* Ehrenberg.
4. *Coscinodiscus robustus* Ehrenberg.

Note.—All of the species shown on Plate V are from the great deposit at Lompoc, California.

CHANGE IN MINE ASSESSMENT YEAR.

The Bureau continues to receive inquiries from more remote sections in regard to the changing of the period for doing annual assessment work on unpatented mining claims, and for the benefit of those who may not be fully advised, the text of the new law is here given.

The law, introduced as H. R. 4813, entitled, 'An Act changing the period for doing annual assessment work on unpatented mineral claims from the calendar year to the fiscal year beginning July 1 each year'; was approved by the President on August 24, 1921, and became effective as of that date.

This law also provides that on all valid claims, the annual period ending December 31, 1921, shall continue to 12 o'clock meridian (noon) July 1, 1922. In other words '1921 work' is extended to noon, July 1, 1922. '1922 work' must be done between noon, July 1, 1922, and noon, July 1, 1923, and so on.

The text of the new law follows:

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 2 of "An Act to amend sections 2324 and 2325 of the Revised Statutes of the United States concerning mineral lands," approved January 22, 1880, be, and the same is hereby, amended to read as follows:
>
> "Sec. 2. That section 2324 of the Revised Statutes of the United States be amended by adding the following words:
>
> '*Provided,* That the period within which the work required to be done annually on all unpatented mineral claims located since May 10, 1872, including such claims in the Territory of Alaska, shall commence at 12 o'clock meridian on the 1st day of July succeeding the date of location of such claim: *Provided further,* That on all such valid existing claims the annual period ending December 31, 1921, shall continue to 12 o'clock meridian, July 1, 1922.' "

PROGRESS REPORT ON PLACER GOLD INVESTIGATION.

By Chas. S. Haley.

The following is a summary of my work on dry placers during the past month:

The district covered embraces San Diego County, Imperial County, and a portion of Riverside County.

Within this district there are several placer deposits, which have been mentioned in previous reports of the Bureau, but not many of them are of any great economic value.

The only placer which appears to have been originated by an ancient river channel is one which comes down from the Julian and Banner districts by way of Ramona and San Vincente creek towards La Jolla. This deposit was worked extensively by Mexicans with dry washers, in the colonial days, and it is believed that that is the best method to work it at present, provided there is any gravel left which is worth while.

In Imperial County there is a deposit of broken down schist carrying some values from disseminated quartz veins, which runs through the Chocolate Basin and the Chucawalla Mountains, and another which runs through the Borego Valley. Neither of these deposits will value more than 15 cents a yard, if worked on any considerable scale.

The only placer deposits in Imperial County which appear interesting at all are a few along the Colorado River. At Laguna and above Yuma, over a million dollars has been taken out by dry washers. The deposit appears to be a disintegrated schist and slate, containing quartz stringers, which have carried some gold.

The erosion caused by the Colorado River at the base of a low range of hills has resulted in the accumulation of this matter. The river wash itself does not carry much value, but the disintegrated matter above has considerable gold in it. The same condition applies to the Picacho Basin, about fifteen or twenty miles above this region. Neither of these deposits appears to be of great interest at present, as most of the gold has been taken out in the only manner in which it could be taken without working large portions of gravel which are practically valueless. The Mexican with his dry washer worked by hand was not up against the problem of overhead in the moving.

In Riverside County near Blythe, there is still a little gravel of the Colorado which carries values, but most of the concentration appears to be on the opposite side of the river, in Arizona. Here the La Paz Gold Mining Company plans to operate with hydraulic, by pumping the water from the river.

PROGRESS REPORT ON SPECIAL MOTHER LODE BULLETIN.

By C. A. Logan.

On account of the protracted storms of the past month, it has not been possible to visit mines or do much field work for the Mother Lode Bulletin. The time available for this bulletin has been used to bring up-to-date a mining map of sections of the Mother Lode and to collect information on the present condition and ownership of patented mines. This work has been carried well forward for El Dorado County.

Many owners now resident in that county, and men who have worked underground in mines closed down for years, have been interviewed to learn as much as possible regarding underground conditions in mines where the workings are at present inaccessible. Past history of operation and production of numerous properties has been gathered. This work is a necessary preliminary to extended field work, which will be completed as soon as the weather permits.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coördination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau Publications have been made available for distribution:

Bulletin No. 89.—Petroleum Resources of California, with Special Reference to Unproved Areas. This publication was written by Lawrence Vander Leck, an oil geologist, of recognized ability in his chosen field. In preparing his report Vander Leck spent twelve months in the field and no part of the state is so remote that it was overlooked when the author wrote down his conclusions as to whether or not oil or gas could reasonably occur there. Information of this character, relative to northern and central California in particular, is available nowhere else, either in government or private documents. The Bulletin is cloth bound, contains 188 pages of text, twelve illustrative drawings, six photographs and six maps. Price *$1.25* including delivery charges.

Preliminary Report No. 8.—A Review of Mining in California During 1921, with notes on the outlook for 1922. The material offered in this review is a compilation of the notes prepared by the Bureau's field engineers, covering various phases of the mining industry which they have observed in the course of their work during the past year. It does not presume to be a detailed record of the mines and mineral deposits of the state, information of that nature being available in the

Reports XIV, XV, XVI, and XVII of the State Mineralogist, as well as in various bulletins which have been issued on particular branches of our mineral industry.

This review does, however, attempt to convey at a glance some idea of the general mining situation here, in 1921, and to mention items of interest which have been noted during that period, particularly as regards new development and activities, as well as to show something regarding the future outlook for this industry. Preliminary Report No. 8 is distributed free.

Summary of operations—California Oil Fields, November 1921, Vol. 7, No. 5.

Mining in California, January 1922 (Monthly) Vol. 18, No. 1.

Oil Field Map No. 16, Ventura-Ojai Fields, Revised to January 15, 1922.

Oil Field Map No. 20, Long Beach Oil Fields, Revised to February 1, 1922.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications Distributed During the Month of February 1922.

Publications.	Number distributed
Report XI State Mineralogist	2
Report XIV State Mineralogist	9
Report XVII State Mineralogist	16
Mines and Mineral Resources of Del Norte, etc.	2
Mines and Mineral Resources of Fresno, etc.	4
Mines and Mineral Resources of Imperial, etc.	2
Report XV State Mineralogist	3
Mines and Mineral Resources of Alpine, etc.	3
Mines and Mineral Resources of Butte, etc.	1
Mines and Mineral Resources of El Dorado, etc.	6
Mines and Mineral Resources of Los Angeles, etc.	6
Mines and Mineral Resources of San Diego, etc.	2
Mines and Mineral Resources of Monterey, etc.	3
Mines and Mineral Resources of Kern, etc.	1
Mines and Mineral Resources of San Bernardino, etc.	10
Plumas County Report	2
Sierra County Report	3
Amador County Report	1
Bulletin No. 6, California Gold Mill Practices	2
Bulletin No. 23, The Copper Resources of California	1
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	4
Bulletin No. 50, The Copper Resources of California	1
Bulletin No. 72, Geologic Formations of California	20
Bulletin No. 75, Mining Laws, United States and California	67
Bulletin No. 76, Manganese and Chromium in California	1
Bulletin No. 77, Catalogue of the Publications of the California State Mining Bureau, 1880–1917	2

Publications—continued.

	Number distributed
Bulletin No. 83, California Mineral Production for 1917	21
Bulletin No. 85, Platinum Resources of California	8
Bulletin No. 86, California Mineral Production for 1918	1
Bulletin No. 88, California Mineral Production for 1919	1
Bulletin No. 89, Petroleum Resources of California, with Special Reference to Unproved Areas	328
Bulletin No. 90, California Mineral Production for 1920	184
County Maps and Register of Mines	27
Geological Map of California (Mounted)	17
Preliminary Report No. 6, Review of Mining in California, During 1919	24
Preliminary Report No. 8, Review of Mining in California, During 1921	1590
Mining in California (Monthly) Vol. 18, No. 1	1620

Mails and files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations issued by the State Commissioner of Corporations.

During the month 832 letters were received and answered. They are practically all requests for information, and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared. The increasing work in this department necessitated making an addition to the force during the past month.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

Statistics.

There are several thousand individual producers of mineral products in California, and the task of compiling accurate and dependable statistics covering their activities is an extremely difficult one.

The Bureau's data is authoritative, all figures, with the exception of those for gold and silver which are supplied through the courtesy of the United States Geological Survey, being obtained by direct communication with the producers.

Since the inauguration of the Monthly Chapter it is possible to publish the production figures for any mineral within a maximum period of thirty days from the date on which the returns are complete.

It is hoped that the early appearance of the figures for some of the minerals will induce other producers to coöperate, to the end that the complete statistical bulletin may be incorporated in one of the early mid-year issues of the Chapter. Blank forms were sent out in January, and the 1921 data are now coming to hand, so that we shall doubtless be in a position to give some of the figures in the March issue.

The dissemination of data on the consumption of mineral products in California, figures for which are rarely obtainable, is a new feature to be forthcoming. This state can easily supply its own needs in many lines, if the consumer will only realize the extent of the natural resources within our own borders. Much material is shipped in here from points outside of California that could be supplied from local sources, and in many cases of equal quality.

Museum.

Last October, following the convention of the American Mining Congress in Chicago at which a display of California's minerals was made (described elsewhere in this Chapter), the writer made a tour of inspection of the principal mineral museums of the United States and Canada. A particular study was made of their installations, the types and construction of cases, and systems of displaying the specimens. The following were visited: Colorado State Museum, and Colorado Museum of Natural History, Denver; Field Museum of Natural History, Chicago; Canadian Geological Survey, Ottawa, Canada; Agassiz Museum, Harvard University, Cambridge, Mass.; Boston Society of Natural History, Boston; American Museum of Natural History, New York; Smithsonian Institution (National Museum), Washington, D. C.; also some private collections in Boston and New York. It is hoped that in the near future we can put into effect in our own museum some features suggested by installations observed during that trip.

Each issue of the Monthly Chapter will contain a brief account of current museum activities. This will include a list of new acquisitions received with names of donors, a report of the number of visitors registered, and other items tending to keep the public advised of the advantages, from an educational standpoint, afforded by the exceptionally fine collection of rocks and minerals of both economic and academic value, comprising the 16,000 specimens on exhibit. The Museum contains not only one or more samples of practically every known mineral found in California, but hundreds of specimens from other states and foreign countries as well. An account of the arrangement and classification of specimens in this collection will be given in an early issue of 'Mining in California.'

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the curator, as well as those who utilize the facilities of the collection.

Among the specimens received recently, and catalogued, for the Museum, are the following:

Nos. 19504 to 19516. Several varieties of polished *Jasper*, utilized for jewelry purposes. From Santa Clara County, California, by H. E. Harper, Santa Clara.

No. 19517. *Uraninite* or *Pitchblende* (uranate of uranyl). From the Kirk mine, Gilpin County, Colorado. Ore from this mine was shipped to Paris in 1900; and up to 1908 all of the radium there produced is stated to have come from 20 T. of high-grade ore from the Kirk mine. Wm. Beddig, donor, Oakland.

No. 19518. *Ferberite* (iron tungstate). From Nederland, Boulder County, Colorado, by Wm. Beddig, Oakland.

No. 19519. *Sphalerite* (zinc sulphide), 'triboluminescent' *Zincblende* variety. Shows light glow in darkness on scratching. From Mariposa County, California, by R. C. Papworth, Oakland.

No. 19520. *Magnesite* (magnesium carbonate). Showing characteristic conchoidal fracture. From Stanislaus County, California, by W. H. Cone, San Francisco.

No. 19521. *Gypsum* (hydrous calcium sulphate). High-grade, massive. From Imperial Gypsum Company's claims near Dixieland, Imperial County, California, by Walter Snook, Maricopa.

No. 19522. *Arsenolite* (arsenic trioxide), artificial. From bag-house fume, Selby smelter, after burning through spontaneous combustion in collecting chambers. C. R. Hilton, donor, Modesto, California.

No. 19523. *Heterogenite* (hydrous cobalt oxide). From Yellow Pine Mining District, Clark County, Nevada, by Oliver E. Conner, Jr., Cleveland, Ohio.

No. 19524. *Copper Ore* (sulphides). From Clarke-Keller mine, Nevada County, California.

No. 19525. *Graphite* associated with pyrite and calcite in gold-bearing quartz, from Norwegian mine, Tuttletown, Tuolumne County, California, by R. Nelson, Tuttletown.

No. 19526. *Dumortierite* (basic aluminum silicate, with part of Al replaced by Bo), from Humboldt Queen Cañon, Pershing County, Nevada, by H. H. Dievendorff and L. D. Gassaway, San Francisco.

No. 19527. *Magnesite* (magnesium carbonate). High grade, massive. From Quinto claims, Stanislaus County, California, by A. D. Davenport, Gustine, California.

No. 19528. *Chiastolite* (var. of Andalusite) (aluminum silicate). From Lancaster, Massachusetts, by Boston Society of Natural History, Boston, Massachusetts.

No. 19529. Lockport *Dolomite* (Niagara group-Silurian). Rim rock of Niagara Falls. From Goat Island, Niagara Falls, New York, by Walter W. Bradley, Berkeley, California.

No. 19530. Mica *Schist* from corner of St. Nicholas ave. and 175th st., New York City, by Walter W. Bradley, Berkeley, California.

No. 19531. Mica-hornblende *Schist*, from foot of Bright Angel Trail, Grand Cañon of Colorado River, Arizona, by Walter W. Bradley, Berkeley, California.

No. 19532. *Sandstone* (red), from Supai formation (early Carboniferous, on Bright Angel Trail, Grand Cañon of Colorado River, Arizona, by Walter W. Bradley, Berkeley, California.

No. 19533. *Malachite* (basic copper carbonate) and *Chalocite* (copper glance), in quartz sand, cementing the grains of sand. From Navajo Indian Reservation, Coconino County, Arizona, by Lloyd C. Ashley, San Francisco, California.

No. 19534. *Iceland Spar* (var. of Calcite, calcium carbonate). Suitable for optical purposes. From near Cedarville, Modoc County, California, by J. D. Patterson, Cedarville, California.

No. 19535. *Chalcedony* (silica), pseudomorph after Barite, with associated bitumen. From Phipps quicksilver mine, San Benito County, California, by Walter W. Bradley, Berkeley, California.

No. 19536. *Gold Ore*, stated to assay over $200 per ton, from Moore mine, Jackson, Amador County, California, by Moore Mining Company, San Francisco, California.

No. 19537. *Witherite* (barium carbonate). Massive. From El Portal mine, Mariposa County, California, by M. C. Seagrave, San Francisco, California.

No. 19538. *Sandstone* pebbles. Water-worn. Flat shape due to jointage or bedding. From Cache Creek, Yolo County, California, by J. D. Bennett, San Francisco.

No. 19539. *Soapstone* (talc) (hydrous magnesium silicate). From near Shingle Springs, El Dorado County, California, by A. W. Prouty, Shingle Springs, California.

No. 19540. *Gold*, crystallized in quartz, from Duncan mine, near Hornitos, Mariposa County, California. Loaned by Dr. David Hadden, Oakland, California.

During the month a total of 371 visitors signed their names on the Museum register, and in addition there are frequently others who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

The correct answers to the queries, What is it? and Has it any value?, questions concerning minerals sometimes incited by mere curiosity, but more often asked by those who have been pioneers in building up the mining and mineral industry of the state, have been the initial step in much of the development recorded in the past forty years.

The State Mining Bureau since its organization has supplied the necessary answer to thousands of cases without cost to the individual; and has been largely instrumental in bringing to light the minerals of both scientific interest and practical utility found in California.

The rapid increase in the number of structural and industrial minerals, and salines, whose character, use and value are seldom recognized without the aid of laboratory tests, has demonstrated the real need of this service.

The constant demand on the laboratory facilities in the past has been gratifying, but it is believed that their usefulness will be increased if the results of the work are published.

A monthly laboratory report, summarizing the determinations made, with notes on those of possible commercial value or scientific interest and other items, therefore appears in each issue of 'Mining in California.'

A list of those of possible value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–30	Magnetite—contains gold
05–31	Gold ore, also platinum
05–32	Chalcedony—blue green gem stone
05–33	Sillimanite
05–34	Magnesite
05–35	Chromite, also andradite
05–36	Sodium sulphate
05–37	Gold bearing quartz
05–38	Gold bearing quartz
05–39	Chalcopyrite—contains gold
05–40	Lead-silver ore, also zinc sulphide with silver and gold
05–41	Manganese, lead and zinc with copper and silver
05–42	Gneiss with cuprite and chalcopyrite
05–43	Clay
05–44	Lead-copper ore—silver and gold present
05–45	Volcanic material — potassium present
05–46	Asbstos—amphibole variety
05–47	Soapstone
05–49	Marl—calcerous
05–50	Silver ore — pyragyrite, high grade, with some gold
05–51	Magnesite—high grade
05–52	Diatomaceous earth
05–53	Sulphur
05–54	Copper ore—gold and silver present
05–55	Barite
05–56	Gold bearing quartz
05–57	Iceland spar—optical grade
05–58	Gold ore
05–59	Pumice
05–60	Corundum—ruby, emery
05–61	Witherite
05–62	Chloropal
05–63	Pumice, also diatomaceous earth and limestone.
05–64	Limestone—good grade
05–65	Pyrophyllite
05–66	Mica—biotite
05–67	Scorodite
05–68	Silicified material, with salts of potassium
05–69	Sand—contains gold
05–70	Thenardite
05–71	Soapstone
05–72	Manganese oxide
05–73	Clay
05–74	Magnetite
05–75	Clay—burns white, also feldspar
05–76	Manganese oxide
05–77	Talc—contains iron sulphide

During the thirty-day period 244 samples were received and determined. In addition to these there were 12 samples brought to the laboratory by people who sought information of an unusual nature, such as the results obtained by fusing an ore with a particular flux, etc. A small percentage of the samples received each month are interesting in a mineralogical if not in a commercial way. Of two such samples received one was a massive impure scorodite (hydrous ferric arsenate) locality not stated; and the second contained true corundum, ruby, crystals disseminated through limestone. The latter came from the Baldy Mountains in San Bernardino County, and judging from the sample submitted, it is possible that the gem variety of corundum, ruby and sapphire, may be found in the deposit. This occurrence is similar to that in which gem rubies are found in Burma. The crystals in the sample received lacked size, only, to make them of commercial value.

For a number of years, a ‘mysterious white metal’ has been reported at irregular intervals from several localities in California, but particularly from the ‘lava beds’ area of Modoc and Lassen counties. In recent months this subject has been given special attention in the laboratory of the State Mining Bureau and by the U. S. Bureau of Mines Experiment Station at Reno, Nevada. The correspondence quoted herewith shows the conclusions reached, and should retire the ghost of this ‘mysterious metal,’ at once and for all time:

"CALIFORNIA STATE MINING BUREAU

San Francisco, California, February 4, 1922.

"DR. S. C. LIND,
Supt. U. S. Bureau of Mines Experiment Station,
Reno, Nevada.

re 'white metal' investigation:

DEAR SIR: "As stated in our letter of April 11, 1921, this subject has come to the attention of the laboratory of the State Mining Bureau at various times during the past twenty years or more. Until recently the samples submitted came entirely from the northern end of the state, particularly Lassen and Modoc counties, and they have invariably been basic igneous rocks, mainly basalt.

"In no case have we been able to reduce or produce any 'white metal' from the materials submitted. Of a number of samples investigated and analyzed, it was noted that the material usually contained rock-forming minerals which rendered the rock rather easily fusible, also the element titanium was present. From the behavior under these tests, our present chemist, Mr. Frank Sanborn, suggests that in fusing the rocks in question it is possible that a piece of iron coming in contact with the molten mass would have a crude iron-alloy formed on the surface—possibly ferro-silicon or a complex ferro-alloy. His conclusion is that the so-called 'white metal' is probably such an alloy.

"He also learned that a friend of his, Mr. C. F. Sherwood, 503 Market street, San Francisco, spent considerable time and money in 1920–21, investigating this 'mysterious metal,' or 'white metal' in hopes that he could form a hard steel with acid-resisting properties suitable for mine pumps, cyanide filters, etc. The rock came from Modoc County, California. The following is a copy of a complete analysis made on this material by Walter L. Gibson, Oakland, Cal.:

"WALTER L. GIBSON,
successor to
Assay Office, Chemical Laboratory,
824 Washington Street,

Oakland, Cal., September 16, 1920.

"The Oliver Sherwood Company,
503 Market street,
San Francisco, California.

GENTLEMEN: "A sack of rock deposited by you at this laboratory for analysis, further known as Lab. 69482, gave the following results:

Silica	44.50%	
Sulphur	0.27	Combined as FeS_2
Iron	0.23	
Iron oxide (Fe_2O_3)	9.89	
Iron oxide (FeO)	7.55	
Alumina	10.51	
Lime	10.00	
Magnesia	3.82	
Titanium oxide (TiO_2)	2.00	
Phosphoric acid	0.90	
Water @ 100 C	2.30	
Water above 100 C	2.00	
Potassium oxide (K_2O)	0.57	
Sodium oxide (Na_2O)	5.10	
Carbonic acid gas (CO_2)	Trace	
Nickel	Trace	
Total	99.64%	

(Signed) WALTER L. GIBSON."

"Mr. Sherwood informed our Mr. Sanborn that his investigations did not yield any results of practical value.

"On several occasions during the past eighteen months when such rocks have come to the State Mining Bureau for identification, we have written the parties, asking for a sample of the metal said to have been reduced; but we have not yet received any in reply. Recently, however, a sample was brought in by a party who had become 'interested in the mysterious metal.' He had a generous sample of the rock and some of the metal claimed to have been reduced from it. This metal resembled the skimmings from a mass of molten solder, and proved to consist mainly of lead with impurities (apparently tin, copper, etc.). This metal could not have come from the rock that was submitted for identification.

"Dr. A. S. Eakle, professor of mineralogy, University of California, states that in the summer of 1915 while in Mono County, California, near Topaz, an occurrence of such a 'white metal' ore was reported to him and that he gathered some samples of the rock which proved to be quartzite containing pyrite. His informant repeated his experiments in Dr. Eakle's presence; and although not as successful in obtaining an actual reduction of metal as in his reported tests, Dr. Eakle says that the following had probably occurred: As the material was heated in a blacksmith's forge, there was plenty of carbon (coal or coke) present to reduce some iron from the pyrite. The iron may have alloyed with some silica to form ferrosilicon, or with some carbon to form steel. The hole made in the shovel in the reported tests may have been made by the sulphur attacking the shovel rendering it brittle at the point of attack or the forge blast may have burned a hole through if the shovel was worn thin.

"Under separate cover we are mailing you samples of rocks from two localities received at this office as yielding the 'white metal.' Needless to say, we found none such in either sample. As our laboratory is equipped for qualitative work only, we are limited in our scope when it comes to research work.

"We will appreciate copies of your report when you have completed these investigations.

Very truly yours,

(Signed) Fletcher Hamilton,
State Mineralogist."

"Department of the Interior
Bureau of Mines
Rare and Precious Metals Experiment Station,
Reno, Nevada.

February 10, 1922.

"Mr. Fletcher Hamilton,
State Mineralogist,
San Francisco, California.

Dear Sir: "I am very much indebted for your letter of February 4th on this subject. The question of 'white metal' has also been brought to our attention repeatedly during the past several years.

"At one time in Colorado we examined very carefully a specimen of rock supposed to contain 'white metal' and were unable to detect anything which should give the properties alleged to iron. Since coming to Nevada, we have reviewed the whole subject very carefully with the Mackay School of Mines, and consulted other authorities. The consensus of opinion seemed to be that there was nothing in the claims whatsoever, and we decided that the problem was not worthy of further investigation and made no publication on the subject.

"If unusual properties are imparted to iron in forging it in the presence of such rock we believe that they are due to the heat treatment and also that a surface alloy may be formed, as suggested by Dr. A. S. Eakle, quoted in your letter.

"We do not propose to make any investigation of the present sample from Modoc County, as we had long ago decided the subject does not merit further work, and we are very pleased to be confirmed in this view by your opinion."

Very sincerely yours,

(Signed) S. C. Lind,
Superintendent.

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are avaliable for reference.

The library and reading room are open to the public during the usual office hours when the librarian may be freely called upon for all necessary assistance.

Official Publications Received.

Governmental.

Smithsonian Institution—United States National Museum, Annual Report 1921.
Smithsonian Institution—United States National Museum, Vol. 24, Pt. 1; New Plants from Guatemala and Honduras.
Smithsonian Institution—United States National Museum, Vol. 12.
United States Commerce Reports
Philippine Journal of Science, August 1921.
Philippine Journal of Science, October 1921.
Kentucky Geological Survey—Vol. IV, Geology of the Golconda Quadrangle.
Canada Department of Mines—Mines Branch, Annual Report, 1920.
Western Australia Geological Survey—Bulletin No. 78, The Mining Geology of Kookynie, Niagara and Taulpa, North Coolgardie Goldfield.
  Bulletin No. 78—The Mining Geology of Comet, Vale and Goongarrie, North Coolgardie Goldfield.
  Bulletin No. 80.—The Mining Centers of Junius and Jasper Hill, Murchison Goldfield.
  Bulletin No. 81.—The Geology and Mineral Resources of the Yalgoo Goldfield.
Boletin Minero—Mexico.
Boletin del Petroleo—Mexico.
Boletin No. 14, Estadistica Minera de la Republic—Argentine.
Boletin No. 4, Sumaria—Argentine.
Geologicas el La Precordillera—Argentine.

Scientific Societies and Educational Institutions.

California Academy of Science, Proceedings—Vol. XI, Nos. 7–8–9–10–11–12–13–14–15–16–17.
Philadelphia Academy of Natural Sciences, Annual Report.
Royal Society of South Australia, Transactions and Proceedings.
Mining and Metallurgical Society of America—Bulletin No. 152.

Official Publications Received—Governmental—continued.

Canadian Institute of Mining and Metallurgy, Bulletin.
Institute of Mining and Metallurgy, London—Bulletin, January 1922.
Schools of Mines and Metallurgy, University of Missouri—Bulletin, the Problem of the St. Peter Sandstone, August 1921.

Books.

Field Methods in Petroleum Geology, by Cox, Dake and Mulenburg.
The Examination of Petroleum, by Hamor and Padgett.

Maps.

U. S. Geological Survey—Orangedale School Quadrangle, Fresno County, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral products or deposits for which a market is sought.

02–35 Silica—high grade lode quartz; now shipping
02–36 Asbestos fiber—lower grades
02–37 Molybdenite
02–38 Cinnabar deposit—new discovery; large
02–39 Gold prospect—San Bernardino County
02–40 Asbestos fiber
02–41 Pottery clay
02–42 Gypsum deposit—in New Mexico
02–43 Potash feldspar—large deposit
02–44 Ochre
02–45 Barytes—Assay: $BaSO_4$–95.98; SiO_2–2.24; Al_2O_3–.29; Fe_2O_3–.25; CaO–1.14 MgO–.44
02–46 Asbestos deposit

Mineral products or deposits wanted.

03–28 Talc—powdered or sawed into pencils; carload lots.
03–29 Feldspar—in Northern California
03–30 Limestone—deposits tributary to Porterville
03–31 Pottery clay, ball clay and fire clay—will test samples of clay from any deposit in California
03–32 'Dash'—⅜-inch screened crushed rock for stucco
03–33 Natural gas—for manufacture of carbon black
03–34 Barite and cobalt—deposits
03–35 Silica
03–36 Asbestos—amphibole

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch offices, in 1919 a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter, is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–4 Superintendent. Age 45. Married. Eighteen years experience, California, South Dakota and Alaska, in dredging, hydraulic and lode mining. Last 10 years superintendent and general superintendent. References. Salary wanted $250.

01–5 Assayer and Chemist. Age 26. Single. Four years experience assayer and chemist; 2 years chemist, cement plant; 2 years chemist, copper company; 2 years in United States Army. References. Salary wanted $175.

BUREAU PUBLICATIONS.

During the past forty-two years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Pacific Finance Building, Los Angeles; in Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield; Auburn and Redding. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all the publications of the Bureau from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

A list of the above, most of which are out of print, and another of those still in stock, for free distribution or sale, revised to the date of publication, appears in each issue of 'Mining in California.'

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau, and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

MARCH, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. Tucker, Mining Engineer.

Shasta County.

The Mascot and *West End group of mines,* situated in the Shasta Mining District, near Whiskytown, have recently been bonded to C. D. Jones and Company of Los Angeles. W. M. Parsons is directing the development work.

It is reported that the *United States Smelting, Refining and Mining Company,* owner of the Mammoth mine and smelter at Kennett, is negotiating for the purchase of the Balaklala mine.

At the *Gladstone mine* in the French Gulch Mining District the drifts and tunnels above the 300-foot level have been cleaned out and retimbered. Ore production has commenced, and ten stamps of the thirty-stamp mill are being overhauled to start milling operations.

The Mount Shasta Silica Company of Weed has been incorporated to develop and mine a large deposit of diatomaceous earth. The deposit is located in the northeastern part of Shasta County, close to the line of the Pacific Gas and Electric Company's railroad from Bartle to Pit River. Nineteen placer locations have been made by the company.

Siskiyou County.

The Lone Pine mine, situated in Squaw Gulch near Cecilville, is being operated by John Maxwell and Chas. Morgan. A tunnel is being driven to cut the vein, at a point where intersecting gold-bearing stringers meet the main ledge.

S. Carpenter and *E. M. Robertson* have started a drift in the gravel bar at the junction of the East and South Forks of Salmon River to cut the back channel in the South Fork run.

Lewis Roff, Almond Strickling and Archie Farnsworth have leased a portion of the *Conzetti Placer mine*, on the South Fork of Salmon River, and are hydraulicking.

W. L. Tickner and *A. G. Brown* are hydraulicking on the East Fork of Salmon River across from the workings on Shadow Creek Flat.

The Cub Bear mine, 12 miles southeast of Etna Mills, has resumed operations. F. A. Gowing of Berkeley is opening up the *Mountain Laurel* and the *Gold Ball Group* of mines near Sawyers Bar.

The Highland mine, 12 miles west of Callahan, is being operated by Herman Mattern of Ashland, Oregon.

Trinity County.

Several placer companies, including dredging, hydraulic and drift, are preparing to resume mining operations along the Trinity River and tributary streams. The active territory includes areas near Weaverville, Junction City and Minersville. The lease of ten acres on the Paulsen ranch, near Lewiston, held by the *Bablew Mining Company* of Los Angeles, has been acquired by the *American-Italian Hydraulic Company.* The new operators have arranged to work the ground with monitors, operating under a head of 100 feet of water from Rush Creek. A large deposit of gold-bearing gravel has been demonstrated, and hydraulicking will start as soon as the banks have been loosened by dynamite. E. A. S. Whittard has charge of operations for the company.

The Union Hydraulic mine near Weaverville has been leased by T. B. Arbuckle, and it is reported that the *Lorenz Hydraulic mine*, a short distance from Weaverville, is under operation.

AUBURN FIELD DIVISION.

C. A. Logan, Mining Engineer.

Calaveras County.

There has been little change in the mining situation in this county during the past three months outside of the favorable developments in the deep levels of the Melones mine, where the Carson Hill Gold Mines, Inc., has been operating.

Angels Camp Deep Mining Company is reliably stated to have spent $90,000 on the mine and $45,000 on the mill up to July 1, 1921.

On the 200-level from the Pioneer Shaft they ran 375 feet, of which 165 feet was on a formation averaging six feet wide, but of too low average grade to pay for milling. On the south end of this drift a crosscut was run and a raise put up to connect with the Hale Shaft. A prospect of good grade which was left by former operators in the Hale Shaft is said to pinch 12 feet below the old sump. On the 400-level from the Pioneer Shaft, only a little crosscutting was done. On the 500-level, a total of 750 feet of crosscuts were run. A crosscut 530 feet long was run to find the lead opened on the 200-level. A formation 32 feet wide was encountered and drifted on for 230 feet, but little ore was found; the question has been raised as to whether this drift was carried far enough south. Early in March it was reported that the company is to be reorganized under the name of the *California Exploration Company.* They are said to be planning to resume sinking the two shafts.

Bullion Hill Mining Company, six miles north of Murphy, continues operation in good ore. A formation carrying lens-shaped ore bodies is being mined now for a length of 135 feet above the adit level, which is 1287 feet long. It is planned to begin sinking a shaft near the face of the adit soon. The five-stamp mill has been turning out over $5,000 a month since milling began, according to the company's officials. Development is being delayed on account of a pending law suit.

Carson Hill Gold Mines, Inc., has purchased Melones mine and plant, with the exception of the power system, for a cash price of $450,000, according to A. D. Stevenot, superintendent. The Melones winze has been sunk to 4000 feet depth, and Mr. Stevenot states that very good ore has been opened and is being drifted on at this depth. The company's plant of 30 stamps and three Hardinge mills is now crushing slightly over 16,000 tons of ore a month. Operating costs have been considerably reduced during the past year.

Calaveras Copper Company is employing only two or three men on development work underground.

Operation has been resumed at the *Sanguinetti Gravel mine* near Vallecita following the installation of a larger pump.

At the *Tanner mine* near Murphy two stamps are running part time on ore taken from development.

Work has been resumed at the *Triple Lode mine,* west of Altaville. A heavier hoist has been installed and underground exploration is going on.

Pacific Asbestos Corporation is the successor of the California Asbestos Company, American Asbestos Company, American Asbestos and Manufacturing Company and the Asbestos Producing Company of California, which in succession since 1904 have made efforts to exploit the property. The company owns 310 acres of patented land and has options on 300 acres adjoining it, in Secs. 15, 16 and 21, T. 1 N., R. 13 E., on the west side of North Fork of Stanislaus River. J. A. Voorhies, manager, 631 Phelan Building, San Francisco.

One thousand feet south of the north end of the property No. 3 adit has been driven north in the serpentine about 170 feet. This shows a good prospect of chrysotile asbestos. Between 200 and 300 feet south of this portal is a shaft now open about 30 feet deep on the west side of the asbestos zone, and 300 feet east of it is a cut and tunnel 40 feet long. Both these show good asbestos prospects. Fifteen hundred feet south of these and 250 feet lower on the side of the river canyon, No. 1 adit has been driven about 250 feet; it is in harder serpentine which does not carry asbestos in the same amount as in the upper workings, although the fiber is in evidence on the surface between the workings. No. 2 adit is 80 feet long and a little above No. 1.

The upper workings mentioned above indicate a promising asbestos-bearing area about 500 feet long and 300 feet wide. The company's engineer, W. J. Woolsey, claims that they have an area 2500 feet long north and south by 1000 feet east and west which is indicated to carry enough asbestos to pay a profit, but this was not all covered by the writer. Mill runs made some years ago are said to have shown about 5% fiber in rock taken from No. 3 adit. The fiber ranges up to one inch in length and appears to be of good quality.

Improvements and equipment include a concrete-covered camp building, ammonia refrigeration plant, 3-drill air compressor, 3 air drills, 2500 feet of air pipe line, blacksmith shop, 4 ore cars, 600 feet of track, electric motors of a total of 200 h. p., 3 miles of 17,000-volt electric line and some asbestos milling and screening machinery from a small mill formerly used experimentally. The company hopes to have a new mill in operation during the present summer, but have not yet begun construction. The property is seven miles from Copperopolis and about the same distance from the railroad at Chinese, which could be reached by bridging the river and repairing an old stage road.

At the *Victor Gravel mine* cemented gravel has been struck, and the company is contemplating erecting a mill.

Other gravel mines in which there is a probability of work being resumed the coming spring are the *Ozark, Bard Hill and Slab Ranch.*

Tuolumne County.

Much activity in reopening old mines and prospects has been evident in this county during the past year. Unfortunately, some of this work has been halted inopportunely after the spending of considerable money for unwatering, repairing and surface plants.

Alabama and *Crystalline mines* at Jamestown are under option to the *Tonopah Mining Company.* The old Crystalline Shaft, 600 feet deep, is being fitted with a new headframe. It will be unwatered and repaired and the old workings investigated. There are two levels driven from this shaft at depths of 283 and 593 feet, respectively, with 3000 feet or more of crosscuts and drifts. The mine is equipped with a good hoist, steam plant and old mill. Electric power will be used. T. C. Black is superintendent.

Belmont Shawmut mine is in operation with 30 stamps of the mill running. A crew of 50 to 60 men are employed underground in sinking and development. A cyanide plant has been put up and is in operation.

Bonanza mine in Sonora was unwatered recently, but activity has been suspended, with practically no new work done underground. There is said to be hope for a resumption of work soon.

Chileno, Santissima, Rice, Stocker, Wilson and *Means, J. A. Gillis, Last Chance, Pine Tree* and *Carrington* claims and other locations on Jackass Hill near Tuttletown are under option to *Nevada Wonder Mining Company,* for whom T. C. Black is superintendent. The Chileno Shaft was down 175 feet when visited March 8 and is to be sunk to 450 feet as soon as possible, according to present plans. A crosscut tunnel is also being driven to explore the hill. The Chileno vein is a stringer lead of quartz and calcite in highly silicified amphibolite schist to the east of the mother lode. Where drifted on at about 150 feet depth the prospect is said to be good. The shaft passes into the footwall at about this depth.

The Chileno is equipped with hoist, 50 h. p. motor, compressor with 75 h. p. motor, and shop. Three shifts are employed in sinking.

Clio mine near Jacksonville on Tuolumne River continues in operation with a few men.

Harriman mine on Tuolumne River near Jacksonville has been undergoing development during the past year with encouraging prospects. Willis Lawrence is in charge as superintendent for a Delaware company.

National mine, in Secs. 23 and 26, T. 1 S., R. 15 E., is being developed under the direction of Robert Thom. The main adit has been run 400 feet with a drift 150 feet east from adit on the Contact Vein, which is a stringer lead on the contact of Calaveras formation and amphibolite schist. This is at a depth of 100 feet. A shaft has been sunk 125 feet below main adit at the face, giving a depth of 250 feet on a vein called the Slate Vein and a drift has been run 25 feet at a depth of 100 feet below the adit.

The mine has a 5-ft. Huntington mill, 3-drill compressor, air hoist, 50 h. p. gas engine and boarding house. There are also ten stamps that have not been erected.

Patterson mine, H. L. Huston, president. R. F. Lewis, secretary. Office, 485 California Street, San Francisco, California. This mine has been completely equipped with a mill and surface plant, and during the past two years a good deal of underground work has been done. The property formerly worked as the Patterson, together with a number of adjacent claims held under option, covers 4700 feet along the strike of the Patterson Vein, with a parallel vein, the Lennan, slightly developed. In the North Shaft the levels down to and including the sixth have been cleaned out and the 4th- and 6th-levels have been extended north. From the South Shaft the 160-level has been run 385 feet south and the 260-level has been run 120 feet south. From the 6th-level in North Shaft crosscuts were driven from the south drift and connection made with the South Shaft. Superintendent A. L. Witney states the Patterson fissure has been opened for a total length of 2200 feet, not, however, continuously nor all in ore. Two lenses of ore have been opened from the South Shaft, according to Witney, one of which he says is 147 feet long and of excellent grade. A depth of 385 feet on the dip of Lennan Vein was reached and it was drifted on in ore for 40 feet on the 400-level. This vein is said to be virgin to the surface, where good prospects are claimed for it.

A stope was started on one ore shoot and about 2700 tons were run through the mill. As this came out in the course of preliminary work, it unavoidably contained a large proportion of waste.

The mine is equipped with a double-drum hoist, 75 h. p. motor, at the main (North) shaft, 2 compressors each with 100 h. p. motor, Wheeler rock breaker with 30 h. p. motor and a small breaker, with a 200-ton storage bin under the crushers. Ore is trammed through a tunnel from this bin to the mill bins. There is a change house for 30 men, a timber-framing shed, 10,000-gallon water tank, office and assay office. In the mill there are 20 heavy stamps, run by a 50 h. p. motor, 14 ft. plates, 5 concentrating tables run by 15 h. p. motor, and clean-up ball mill. A partly built cyanide plant contains 7 new redwood tanks and some machinery. It is hoped that the suspension of work is only temporary.

At the *Rawhide mine* some superficial work was done in the summer of 1921. Quite a sum of money was spent without accomplishing much, as the promoters were disappointed in the expectation of developing a new ore shoot. It appears that they were too sanguine regarding a prospect of free gold which they found on the surface. A small Gibson Mill was used for crushing a little rock, but the old works were not repaired.

Santa Ysabel mine (Nyman Consolidated) is 2½ miles southeast of Jamestown on Quartz Mountain. Repair work and reopening of the old workings has been under way at this property under the direction of W. W. Hurt.

Springfield Tunnel and Development Company has been delayed longer than expected in opening up the gravel in their claims under Table Mountain. A good prospect was reported several years ago in a shaft, but the water could not be controlled. A long drain tunnel has been driven to carry off this water. In approaching the old shaft with this tunnel, bad ground is said to have been struck and the work of draining the water has been slow, but it is believed the objective will be reached very soon.

Work has lately been started on the *Parole mine,* 3 miles north of Soulsbyville, and on the *Basin Slope* claims east of the North Fork of Tuolumne River. Early operation has also been promised at the *Hidden Treasure, Spring Gulch* and *Paymaster* on the East Belt southeast of Tuolumne, and at the *Verdun* claims on the Mother Lode near Stevens Bar bridge. A Keystone drill has been taken to the Russell Ranch in the Mountain Pass district to prospect for gravel.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Field trips were taken during the past month into Santa Clara County and through portions of Stanislaus, Madera, Merced and Fresno, lying in the San Joaquin Valley.

Conditions in general relative to the mineral industry in these regions were found to be rather quiet, although various plans for new development are only waiting on favorable weather and improvement in roads which will come with the dry season.

The following notes touch upon activities not previously recorded by the Bureau, or on changes which have taken place since last visited by a representative of this office.

Fresno County.

Mrs. Alice D. Hines, 1019 N Street, Fresno, California, owns three gypsum claims, 18 miles west of Dos Palos, containing a deposit of what is said to be high-grade material.

The property is equipped with a small grinding plant and necessary camp buildings.

Plans were completed by Mr. Hines for placing this property on an active producing basis, but were not consummated on account of his death some time ago. The entire group of claims, together with all equipment, is now offered for sale or lease.

Madera County.

Minarets and Western R. R., T. O. Russell, consulting engineer, 1514 H Street, Fresno, California.

The construction of this railroad by the *Sugar Pine Lumber Company of California*, while intended primarily as a lumber road for the use of the company, is of interest to the mining public, as it will be a common carrier, and when completed will be ready to accept all business offered.

Work is now being carried on from eight construction camps located at various points along the right of way.

The road will be about 56 miles long. It starts at Friant, Fresno County, but extends back into the high Sierras altogether in Madera County, traversing T. 10 S., R. 21 E.; T. 9 S., R. 21 E.; T. 8 S., R. 22 E., and terminating in the west half of T. 7 S., R. 23 E.

This entire district is more or less mineralized, but large-scale development has been retarded by lack of transportation facilities.

Among the mining towns which will be within a very short distance of this railroad are O'Neals, Coarse Gold and Fresno Flats.

The immense undeveloped iron ore deposts in the Minarets and in the vicinity of Mt. Raymond are also placed in a position where their exploitation would be much more feasible than it has been in the past.

It is understood that the contracting company which is building the railroad has given bonds guaranteeing its completion not later than April 1, 1923.

Jas. O. Rue, Box 665, Madera, California, has located a deposit of what appears from surface indications to be pure calcite in the Kaiser Mountain district, about 1½ miles from the Huntington Lake road. According to Mr. Rue, there would be no stripping necessary to work this deposit, the croppings of which are calcite crystals which resemble a mass of rock salt.

No development work has as yet been undertaken, but the width of the deposit is said to average 1200 ft. and has been traced along the strike for over a mile.

Merced County.

California Pottery Company, whose new plant at Merced was noted in the January Chapter, has met with such success that it is reported that plans are now under way to increase the installation from four kilns, now operating, to sixteen, in the near future.

The activity in building and the consequent demand for structural tile in the San Joaquin Valley is held responsible for the expansion of the pottery company's activities.

Santa Clara County.

Bernal Marl Fertilizer Company, Jas. A. Gantier, manager, 100 Grant Street, San Jose, California. L. W. Stetson, sales manager, care Hunt, Hatch and Company, Oakland, California.

This company owns and operates a limestone quarry on the east slope of the Santa Teresa Mountains, three miles by road southwest of Edenvale.

The limestone bed covers about 100 acres, and according to test drill holes averages over 200 feet thick. It varies in character from a calcareous marl containing an abundance of shells to a fine grained bluish gray limestone.

This material is quarried for use as a fertilizer or soil corrective, equipment at the quarry consisting of a P. & H. gasoline-driven excavator mounted on caterpillar trucks, the rock being hauled to the mill, a distance of about one-quarter mile, by truck.

The mill, which has just been enlarged and rebuilt, is arranged as follows:

The marl passes from the receiving bins by means of a mechanical automatic feeder to a Williams Hammer Mill, which will take sizes up to 30″ x 24″. It is steam jacketed so that the product is thoroughly dried while being crushed. Driven by 200 h. p. motor at high speed, and said to have a capacity of 500 tons in 24 hours.

The crushed material is taken by belt conveyor from the hammer mill to a Hummer Shaking Screen, which delivers product through 80 mesh to a patent sacker, from whence it is trucked about 1½ miles to the railroad.

Oversize from the Hummer screen is passed through a Williams Pulverizer and then to the sacking machine, and a certain amount of impalpable dust created at the screen is drawn off by a suction fan and sacked separately. This 'dust' is said to have peculiar properties, on account of its extreme fineness, which make it more valuable than the ordinary finished product.

A total of 500 h. p. of electric energy is consumed throughout the plant. Future plans of the company include the construction of a spur track from the main line of the Southern Pacific Railroad south of Edenvale and the installation of a tram line from the quarry to the mill, thus doing away with truck haulage both with the raw material and finished product.

The demand for agricultural limestone and marl, or 'Agstone,' as mentioned in a special article on another page of this publication, is rapidly increasing and it is believed that this industry has a promising future.

Stanislaus County.

Yankee Hill Gold Mining Company's dredge, described in Report XVII of the State Mineralogist, p. 254, has been sold to the *Quartz Creek Dredging Company* of Lewiston, Idaho.

This dredger was launched in May, 1920, but soon after digging operations were started it was torn from its moorings in the Stanislaus River, about 1½ miles below Knights Ferry, by a freshet, and has laid ever since on a sand bar above Orange Blossom bridge, east of Oakdale.

It is understood that the Idaho company will dismantle the dredge and remove the machinery.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Imperial County.

A large deposit of limestone has been located by *John Agnall* of Oasis, Imperial County. The deposit lies about six miles southwest from Oasis, and is within two miles of the State Highway. There is easily visible a tonnage of five million. The limestone body is underlaid by granite. Several samples of the limestone showed on analysis better than 90% $Ca\ Co_3$.

Kern and San Bernardino counties.

There is no mining camp today that merits the attention of the public in general, and the mining public in particular, more than the Randsburg district, which as used here includes Randsburg, Johannesburg and Atolia.

Born as a gold camp the last decade of the nineteenth century, it produced close to $15,000,000, up to the beginning of the World War. Gold mining then almost disappeared, due to high costs, but when conditions looked worst the war demand for tungsten resulted in at least a $10,000,000 production of this metal from the district. With the war over, further mining of tungsten proved unprofitable, and prospects for the district looked far from rosy. At this most critical period, however, Randsburg was rejuvenated by Ham Williams' discovery of the Kelly mine, officially known as the California Rand Silver, Inc.

There are now 24 companies in the district. Of these, 14 are sinking shafts and all appear properly financed for real, legitimate mining.

The following is a list of these companies:

Bojo Mining Company; five claims; Baumgarden brothers and W. W. Leidley, Bakersfield. E. Hollowell, superintendent.

California Rand Silver, Inc.; Charles E. Meroney, general manager; Alfred Harrell, president.

Coalinga Mining Association; four claims. B. B. Eldren, superintendent.

Comstock Rand; five claims. Boca and Benko.

Grand Eagle Mining Company; six claims. A. H. Dixon, president. A. B. Day, superintendent.

Hidden Vault Hillside Mining Company; one claim, 120-acre placer. J. J. Kelly, general manager.

Kelly Rand Extension; one claim. J. C. Walser, president. A. C. Tupman, secretary.

Kern Rand Silver Mining Company; 11 claims. J. B. Dorsey, president. William Quackenbush, general manager.

Middle Rand Silver Mining Company; 15 claims. A. H. Swallow, president. M. Albertoli, superintendent.

Mizpah-Montana Mining Company; two claims. Riley Hughes, general manager.

Mojave Rand Mining Company; six claims. J. T. Martin, superintendent.

Monarch Mining Company; 16 claims. A. T. Kisselburg, president.

Myra Queen Mining Company; six claims. W. C. Borchers, president. George A. Hill, superintendent.

North Rand Silver, Incorporated; eight claims. W. J. Quackenbush, president. W. J. Williams, general manager.

Vienna Mining Company; 1 claim. G. A. Peer, president. J. T. McGillis, superintendent.

Pittsburgh-Mount Shasta Mining Company; seven claims. T. B. Scott, president. D. A. McCormick, superintendent.

Randsburg Silver Mining Company; three claims. J. W. Kelly, president. H. Alderson, superintendent.

Rand Silver Mining Company; three claims. B. R. Bray, president. Mr. Fitzgerald, superintendent.

Silver Bar Mining Company; two claims. C. F. Johnson, trustee.

Silver King Mining Company; four claims. Ed Gallaher, general manager.

Silver Lake Mining Company; 14 claims. S. H. Norris, president.

Silver Moon Mining Company; one claim. George Gallaher, general manager.

Silver Reef claims of Flynn and Elkins.

Silver Wave Mining Company; nine claims. Ross C. Miller, president. Kent S. Knowlton, secretary.

Stampeder Mining Company; six claims. Floyd Barnett, owner.

Wildcat Mining Company; four claims. Grady and Sill, owners.

Gold properties.

Yellow Aster Mining and Milling Company; J. C. Nicholson, general manager.

King Solomon Mines Company; J. Shipsey, general manager.

Baltic Mining Company.

Pinmore Mining Company.

Phoenix Mining Company; Mrs. Rose L. Murcham, owner.

These companies now employ close to 400 men, of which 125 are credited to the California Rand Silver, Inc.

The geology of the Randsburg Quadrangle is ably presented in Bulletin No. 430-A of the United States Geological Survey, by Frank L. Hess, and it is recommended to all interested in the region.

Mr. Ed Smith is developing a promising gold prospect a few miles from Afton Station on the Salt Lake Railway.

The unit system of oil financing introduced by Fred B. Foster Company, Texas operators, has been extended into the mining business by the A. M. Fuller Company, owners of the *Silver Dyke Mining Syndicate*, whose property is situated in the Rand mining district, Kern County.

The claims are located near the 'Kelly Mine' of the California Rand Silver, Inc., and other valuable properties.

The syndicate fractional parts are called 'mineral assignments,' instead of 'units' as in the oil business. These are being marketed at $100 each, there being 2000 all told. The owner of one assignment gets 1-2000th of the production, less the same proportion of the actual expense of operation.

San Diego County.

It is reported that work will be resumed in the near future on the *Chariot mine* in the Julian Mining District of the Cuyamaca Mountains.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

Kern County.

Balboa Oil Company, in Section 24, T. 31 S., R. 23 E., M. D. B. and M., reports an excellent showing of oil at about 3000 feet in well No. 1. 8¼-inch casing was cemented at 2913 feet.

On account of surplus of production and the rapid filling of storage, several of the larger companies in the Midway district have curtailed production of oil, either by closing in or entirely shutting down wells. Curtailment of production during February, 1922, in the West Side fields of Kern County amounted to between 13,000 and 14,000 barrels of oil daily.

Los Angeles County.

Recent developments at Santa Fe Springs oil field, in Los Angeles County, have demonstrated the probable existence of an important commercial gas zone in that field. Three wells have gone wild while drilling through the gas zone, between depths of 2000 and 2500 feet. These wells, No. 'Alexander' 1, No. 'Bell' 2, and No. 'Howard' 1, were being drilled by Union Oil Company. Wells No. 'Bell' 2 and No. 'Howard' 1 lie about 2600 feet apart and both are probably very close to the axis of the anticlinal structure. In each instance the gas blowout completely wrecked the derrick and operating structure and formed a large crater around the drill hole. The gas flowing from the craters of wells No. 'Bell' 2 and No. 'Howard' 1 caught fire and burned with great intensity. The flow of gas was gradually checked by the weight of quantities of clay and sand, caving off the sides of the craters, and water and mud which was pumped into them.

Napa County.

It is reported that Associated Oil Company has acquired some land in Berryessa Valley, in Napa County, and will drill a well on Section 29, T. 8 N., R. 3 W., M. D. B. and M.

Vander Leck[1] reports several seepages of oil in the Knoxville shales in this area. They are found in the southwest quarter of Section 25, T. 9 N., R. 3 W., M. D. B. and M., on the J. W. Harris Ranch, and in the southeast quarter of Section 34, T. 11 N., R. 4 W., M. D. B. and M., on the Zem Zem Ranch; also on the 300-foot level of the Knoxville mine. A few wells were drilled in the Valley in 1904 and yielded a small production of oil.

---

[1] Vander Leck, Lawrence. Petroleum Resources of California, California State Mining Bureau, Bulletin 89, page 52, 1921.

A matter of particular interest, in connection with the showings of oil in the Berryessa Valley, is the report that the oil contains ichthyol.

Ichthyol is a peculiar form of asphaltic material employed in pharmaceutical practice as an antiseptic and medicament. When used in an ointment it is said to have great penetrating qualities.

The scarcity of true ichthyol in the United States has resulted in much research work seeking to extract ichthyol oil from domestic bituminous material. Thus far true ichthyol has been produced only in Austria, and since the war it has been increasingly difficult to obtain.

Ichthyol is produced by the Ichthyol Company of Hamburg. Synthetic ichthyol, of an inferior quality, has been made. The raw material comes from bituminous rock, filled with fish—hence the derivation of the name ichthyol—near Seefeld, in the Austrian Tyrol.

The material mined at this place is carefully selected and subjected to dry distillation. The distillate, ichthyol oil, is then sulphonated. The resultant ichthyol sulphonic acid is neutralized with concentrated ammonia and water. It is then evaporated to the consistency of syrup. Its efficiency as an alterative and antiseptic is ascribed to the sulphur it contains.

American-made substitutes, synthetically derived, sell for $3.50 to $5 per pound. True ichthyol ranges much higher in the New York market. It was quoted and sold at from $12 to $36 per pound during 1916 and 1917.

San Luis Obispo County.

Indian Dome Oil Company is drilling on the Miossi Rancho near Fismo. Well No. 1 is 510 feet deep, with 12½-inch casing.

Santa Barbara County.

Hurst and Leonis are drilling a well in the hills nine miles east of Lompoc, Section 33, T. 7 N., R. 33 W., S. B. B. and M. This well is being drilled with cable tools, using a gas engine for power.

The Puritan Oil and Refining Company is drilling three miles west of Santa Barbara on a mesa about 500 feet from the ocean shore. A showing of oil was reported at 56 feet.

From February 11, 1922, to and including March 4, 1922, the following new wells were reported as ready to drill:

Company	Section	Township	Range	Well	Field
Kern County.					
Pacific Oil Company	35	30	24	36	Elk Hills
Pacific Oil Company	31	30	24	15	Elk Hills
Pan American Petroleum Company	1	31	24	6-E	Elk Hills
Pan American Petroleum Company	1	31	24	2-E	Elk Hills
W. R. Ramsey	1	31	24	1-B	Elk Hills
W. R. Ramsey	1	31	24	2-B	Elk Hills
Standard Oil Company	11	28	27	3	Kern River
Union Oil Company	11	28	27	3	Kern River
Frank S. Wallace	10	30	22	1	McKittrick
American Oilfields Company	36	31	22	103	Midway
Boston Pacific Oil Company	32	31	24	9-B	Midway
C. C. M. O. Company	22	31	22	21	Midway
C. C. M. O. Company	4	32	23	3	Midway
C. C. M. O. Company	22	31	22	18	Midway
Consolidated Mutual Oil Company	28	31	23	14	Midway
Honolulu Consolidated Oil Co.	6	32	24	2	Midway
Honolulu Consolidated Oil Co.	6	32	24	4	Midway
Honolulu Consolidated Oil Co.	6	32	24	7	Midway
Honolulu Consolidated Oil Co.	6	32	24	8	Midway
Pacific Oil Company	31	31	24	23	Midway
Pacific Oil Company	35	31	23	4	Midway
Pacific Oil Company	27	31	23	20	Midway
Pacific Oil Company	7	32	24	40	Midway
B. B. and O. Oil Company	28	12	24	18	Sunset
C. J. Berry	34	12	24	8	Sunset
Wesco Petroleum Company	36	29	20	19	Temblor
Los Angeles County.					
Dabney Syndicate	29	4	12	6	Long Beach
General Petroleum Corporation	19	4	12	1	Long Beach
Holly Oil Company	35	5	11	2	Long Beach
Shell Company	29	4	12	1	Long Beach
Transport Oil Company	30	4	12	1	Long Beach
Occidental Petroleum Corporation	31	4	15	1	Newhall
Turner and Trickett	4	3	15	1	Newhall
B-G-T Oil Company	5	3	11	1	Santa Fe Springs
General Petroleum Corporation	5	3	11	68	Santa Fe Springs
General Petroleum Corporation	5	3	11	52	Santa Fe Springs
George F. Getty	5	3	11	1	Santa Fe Springs
Petroleum Midway Company, Ltd.	5	3	11	1	Santa Fe Springs
Monterey County.					
Danish Oil and Development Co.	24	15	2	1	
Napa County.					
Associated Oil Company	29	8	3	29-1	
Orange County.					
Amalgamated Oil Company	34	5	11	3	Huntington Beach
Miley-Keck Oil Company	2	6	11	14	Huntington Beach
Miley-Keck Oil Company	34	5	11	10	Huntington Beach
Miley-Keck Oil Company	2	6	11	17	Huntington Beach
Miley-Keck Oil Company	2	6	11	15	Huntington Beach
Miley-Keck Oil Company	34	5	11	9	Huntington Beach
Moore Syndicate	2	6	11	1-B	Huntington Beach
Rhoads Oil Company	11	6	11	4	Huntington Beach
Seal Beach Oil Company	14	5	12	1	
Merchants Petroleum Company	33	3	9	4	Richfield
Merchants Petroleum Company	33	3	9	8	Richfield
Merchants Petroleum Company	33	3	9	6	Richfield
Santa Barbara County.					
Standard Oil Company	Rancho San Carlos de Jonata			2	Los Alamos
Santa Cruz County.					
Danish Oil and Development Co.	Rancho Refugio			1	
Ventura County.					
Cooper Petroleum Company	33	2	20	40	Sespe
Wininger-Johnson Syndicate	1	4	20	1	Conejo

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

NOTES ON IRON ORE OCCURRENCES IN CALIFORNIA.

By E. S. Boalich.

During recent years increasing interest has been shown in the occurrence of iron ores in California, which might be of commercial importance.

In the past very little attention has been given to the exploitation of these resources, but this has never been due to lack of ore. No cheap coke has been available in the State, and economic conditions have not been favorable for the development of an iron smelting industry.

The records of the Mining Bureau contain a great deal of scattered information relative to the occurrence of iron deposits from Shasta County in the north to Riverside in the south.

A few years ago plans were made by the Bureau to have a formal report written on this subject, following a field survey of the entire State. These plans had to be set aside, due to several unforeseen circumstances. Although this investigation will eventually be carried on, there is no immediate opportunity to do so because of inadequate funds.

In the endeavor to temporarily meet the situation which arises when an inquiry as to the State's iron ore resources is received, the following notes have been prepared, simply using the Bureau's files and records as a source of data. The individual investigator will find the original records available for reference if at any time he should wish to go into the subject thoroughly. These notes will indicate something as to the wide distribution of iron ores here and will, it is hoped, offer a starting point to those who are looking for such information and who have not been successful in finding it.

The subject matter is segregated by counties, alphabetically arranged, and is given as briefly as possible.

Butte County.

Several claims have been located on showings of iron ore within an area of five or six miles in the foothills about 25 miles northeast of Chico; practically no development work has been carried on to date.

Calaveras County.

Iron ore occurs in large amount a short distance north of Murphy, and a prospect is also reported near Valley Springs.

El Dorado County.

At a point eight miles northeast of Folsom there is situated an iron mine which was once developed by three shafts, the deepest one of which is 312 feet.

Los Angeles County.

A deposit of magnetite exists a short distance from the Southern Pacific Railroad at Russ Station, Soledad Canyon. Some years ago a small furnace using oil as a fuel was erected at the deposit, but proved a failure.

Another deposit of undetermined size has been worked in a small way about ten miles northwest of Acton.

Madera County.

In the eastern portion of Madera County, on the southern slope of the Minaret Mountains, there is a deposit of magnetite which appears to be very high grade and which has been traced for more than 2000 feet in length. It averages 400 feet wide for that entire distance, and has been exposed by erosion on the northeast end for a depth of 250 feet. On the basis of these figures, there should be 30,000,000 tons of iron ore available, and development might easily show a greater amount.

On the west slope of Mount Raymond a little development work has been done on some immense bodies of magnetite and hematite ore, the amount of which has never yet been estimated.

Nevada County.

There are two distinct exposures of iron croppings in this county, southwest of Nevada City, indicating an iron belt about 15 miles long. No real prospecting has ever been done in this area.

Placer County.

A considerable deposit of magnetic iron ore occurs near Hotaling, five miles northwest of Clipper Gap. Over 15,000 tons of pig iron were produced here in 1883 by the California Iron and Steel Company, but lack of a cheap fuel has prevented further development.

Plumas County.

Magnetite of unknown extent, but of fair quality, occurs at various points in Plumas County, notably in T. 22 N., R. 9 E.

Riverside County.

In the Eagle Mountains in Northern Riverside County there occurs an extremely interesting deposit of high-grade iron ore, which was described in detail in Bulletin No. 503, issued some years ago by the United States Geological Survey. From tests made, the content of metallic iron in the ores averages between 64 and 67 per cent, and no impurities, such as phosphorus, are present in sufficient amount to be injurious.

For comparison, it may be noted that the ore mined in the Lake Superior District averages less than 58 per cent metallic iron. The largest single deposit in this district is exposed for a distance of nearly 6000 feet. A moderate estimate of the total quantity available in the Eagle Mountain deposits now exposed is about 75,000,000 tons.

This estimate might be immeasurably increased if it should be assumed that the ore-bearing beds continue farther down the dip than they have been exposed by erosion.

San Benito County.

Numerous surface indications of iron ore are found on the Mount Hamilton Range of mountains, particularly between Stayton and Panoche Pass.

San Bernardino County.

The existence of large iron ore deposits in the desert region of San Bernardino County has long been known. It has been estimated that at least 20,000,000 tons of high-grade ore are available in the better known deposits alone, such as the Cave Canyon Group, north of Baxter; Iron Age, east of Dale; Iron Mountain Group, ten miles west of Silver Lake; and Providence Mountain deposit, four miles east of Kelso. Other deposits occur in the Kingston Mountains, west of Amboy, south of Blythe Junction, and in the lava beds south of Daggett.

San Diego County.

The occurrence of a belt of iron ore has been noted a little north of Julian, and a second deposit, made up principally of hematite, is reported in Eagle Feak Canyon.

San Luis Obispo County.

A deposit of iron ore, said to outcrop at intervals for over four miles, is exposed five miles west of San Luis Obispo. This deposit is within eight miles of deep-water transportation at Port Hartford.

Shasta County.

Shasta County is capable of supplying iron ore for an important industry. There are permanent deposits on both sides of the Pit River, and also extensive surface indications north of the Pit River and east of the McCloud River.

For several years an electric smelter was operated at the town of Heroult on the Pit River, but it is understood that operations had to be suspended because it was not possible to meet Eastern competition.

Sierra County.

There is a large deposit of iron ore in Secs. 11 and 14, T. 21 N., R. 11 E., about ten miles by road and trail northwest of Sierra City, at an elevation of 7000 feet.

Siskiyou County.

Iron ore has been noted at several points along the Klamath River.

Sonoma County.

Three miles inland from Fisk's Mill on the Lancaster Ranch a body of iron ore has been slightly exploited. It is part of a belt running north and south for miles along the coast.

Six miles east of Fort Ross is a considerable body of hematite which strikes in a northerly direction.

On the west fork of the Gualala River is a large body of hematite.

Tehama County.

Important indications of iron deposits have been noted in the vicinity of Beegum.

Conclusion.

The following references on iron ores in California are to be found in many public libraries and in all offices of this Bureau:

Report I of the State Mineralogist.
Report IV of the State Mineralogist.
Report V of the State Mineralogist.
Report XII of the State Mineralogist.
Report XIII of the State Mineralogist.
Report XIV of the State Mineralogist.
Report XV of the State Mineralogist.
Report XVII of the State Mineralogist.
State Mining Bureau Bulletin 38, Structural and Industrial Materials of California.
U. S. Geological Survey Bulletin 213, Contributions to Economic Geology, 1903
U. S. Geological Survey Bulletin 225, Contributions to Economic Geology, 1904
U. S. Geological Survey Bulletin 430, Contributions to Economic Geology, 1910
U. S. Geological Survey Bulletin 503, Iron Ore Deposits of Eagle Mountains, 1912
U. S. Geological Survey, Mineral Resources of the United States. [Various years.]

ECONOMIC MINERALS OF THE AVAWATZ MOUNTAINS.

By W. Burling Tucker.

There are two general types of economic deposits in this area of San Bernardino County, those found in the igneous and metamorphic rocks, such as talc, limestone, barite, metalliferous ores, etc., and those included within the Lake Beds, such as salt, gypsum, celestite, ochre, and many other products, the quantity and value of which have not yet been determined. These two types are geologically greatly dissimilar, but outcrop in such a way as to be closely associated geographically.

Areas of igneous and metamorphic rocks include the ridges of limestone in which the chief mineral resource is talc. Besides this product, there is considerable barite, and indications of copper, silver, gold and iron.

Talc.

The talc in this region was observed to occur always at contact of, or very close to, a certain dark basic igneous rock, which exists as dikes or sills. In every case the other contact rock was a belt of impure limestone and white or greenish chert. The talc is evidently an alteration of amphibole, probably the variety tremolite, formed by contact metamorphism between igneous rock and impure limestone. The talc is pure white to light gray in color, and varies in hardness from solid outcrops, which are moderately hard, to very soft, crumbly masses.

The talc near the intrusive rock is usually the softest and the purest. It is bedded in the limestone, evidently as a result of the metamorphism of certain layers of limestone. During the alteration from tremolite to talc, silica separates out and now occurs as nodules and seams throughout the talc; the silica is in very small amounts. Four deposits were examined. The three largest are at Sheep Creek and the fourth is northeast of Jumbo Salt.

The deposits at the mouth of Sheep Creek are in an impure limestone zone about 125 feet in thickness. Most of the talc is found in the fifty feet next to the igneous intrusion, the best being right at the contact. Of this fifty feet, about one-half is talc of the soft and hard varieties. A cut near the top of the cliff has penetrated the talc for 15 to 20 feet at about a 45-degree angle to the bedding. About two-thirds of talc exposed is soft white talc, the other one-third being hard gray talc. A cut near the base of the cliff was started in the igneous rock, but has not yet penetrated the talc. About 600 feet to the west is another drift into good quality talc at the igneous contact. Thirteen hundred feet westward, along the outcrop from Sheep Creek, the deposit is displaced by cross faulting, on the west side of which the limestones are no longer vertical, but dip southerly into the hill at about 10 degrees, and the igneous rock is in the nature of a sill overlying it. The talc here underlies the gabbro. Southwest of the Sheep Creek talc area there are two discontinuous zones of talc in the face of the hill, which follow a gabbro dike. This deposit varies in thickness from five to ten feet, the thickest and best exposed being at the cut. The deposit northeast of Jumbo Salt is likewise associated with a gabbro intrusion, the dip of which is 30 degrees southerly. This deposit appears to be of a very good material and quite extensive. In thickness this mass of talc averages over ten feet, of which five feet is good quality. The Sheep Creek deposit outcrops for 2000 feet with a width of 50 feet. Estimated tonnage of 400,000 tons. The other deposits are not as large.

Barite.

Barite exists in large quantites over a portion of the gneiss areas, especially from the Jumbo Salt deposit westward. The mineral occurs in veins and seams through the gneiss or as masses in the many gash veins, which criss-cross the gneiss in all directions. As a result, it is well disseminated throughout the gneiss masses, and concentrated in but a few places. Most of it is closely associated with dark hematite material, from which it could be separated only with difficulty. It is more or less stained with hematite, which would exclude it from the principal uses, which are as a paint pigment and filler for paper. No deposits were seen which appeared to be concentrated enough or sufficiently free from iron to make them of much value. The largest quantities of barite were observed on the north side of the middle granite ridge on both sides of Pipe Line Wash.

Limestone and Marble.

The marble occurs in a broad belt striking across Sheep Creek Canyon, and is in inexhaustible quantities. It is highly crystalline, but as is to be expected in such a large mass, grain and color vary greatly. Some of the marble is perfectly white, has a fine even texture, is not grained or banded by colored minerals nor does it discolor on exposure. Most of it is banded and seamed with gray material, like marble used for surface flagging. The marble is a mile and a half to two miles above Lower Sheep Creek Spring.

Gypsum.

There are extensive deposits of gypsum in these properties that are suitable for manufacture of plaster to the amount of many millions of tons.

With an average bedded thickness of 250 feet for the gypsum series, which outcrops over an area nine miles by one mile, it can be readily seen that even a small per cent of the whole would give inexhaustible quantities.

Gypsum of all grades of purity can be had here. In many places the gypsum is found in positions unusually favorable for mining. If necessary, it can be extracted practically free from clay.

ANALYSIS.

Sand and clay insolubles	Salt	Calcium carbonate	Calcium sulphate	Water	Total	Pure gypsum
2.32%	0.05	1.16	74.12	19.74	97.39	93.86%

Salt.

Salt is found in the deposits in enormous quantities. It occurs in a zone above the gypsum. The exact thickness of the salt beds could not be determined, but abundant evidence was secured to show that every deposit was at least 100 feet, and that the full thickness, near what is known as the Valley Salt deposit, would be over 250 feet. In fact, one section measured west of this deposit shows about 500 feet thickness. These measurements apply to a series of rock salt, saline clays and sands. Possibly the pure rock salt beds are in the minority, but the exact proportions can not be estimated at the surface. The gypsum series has an average thickness of about 150 feet, and while there is no set rule for proportion of gypsum and salt in solution in large lakes, salt is nearly always greatly in excess, and almost never in small proportions. This fact, in conjunction with the shrinkage of the old lake before salt could be deposited and the consequent concentration of salt in low places makes it certain that several hundred feet of solid salt is to be expected.

Salt series is:

The salt is overlaid with saline clay and sands.

Reddish muddy shales and sand impregnated with salt and thin salt beds.

Rock salt often of great purity, individual beds often very thick, 50 feet or over, interstratified with insoluble clay, sand and anhydrite; total thickness and proportion of salt to insoluble material unknown. Basil beds, clay of buff color, separating salt from gypsum, 35 to 50 feet in thickness. Sometimes has thin salt and gypsum interbedded. The salt is usually massive and does not show crystalline structure. The color is usually reddish or brown, though there are occasional seams of clear white salt. The discoloration is due to small quantities of iron oxide and insoluble matter. The latter is usually clay, disseminated through the mass in small irregular seams. Chemical analyses show purity as high as 98 per cent. It is likely that good workable beds will be found averaging this or a greater purity, though the average for the whole series is probably less. Estimates of quantity are difficult to make, on the information at hand. However, the data is sufficient to show conclusively that millions of tons could be mined without going below the surface. There are places where the salt stands over a hundred feet thick, above the canyon bottoms.

Celestite.

The mineral celestite is strontium sulphate ($SrSO_4$) with theoretical proportions of $SrO=56.4\%$ and $SO_3=43.6\%$. The pure mineral is white and occurs crystalline, in nodules or massive. It is notably heavy and resembles barite. It has about the same hardness as limestone.

The celestite deposits underlie the gypsum strata. It occurs in enormous quantities, several measured outcrops showing zones of 10 to over 20 feet of celestite, and as a rule it follows the line of contact at the base of the gypsum. It is usually dark brown at the outcrop, though often light colored on fracture. It is associated with jaspers and chalcedony, with which it was evidently precipitated and which often replaced it. Millions of tons can be had by going only 100 feet below the surface of the canyons. In favorable localities, as at Salt Basin, the celestite directly backs good gypsum, so that the celestite can be removed from the same workings after the exhaustion of the gypsum.

At this place, which is characteristic of other deposits, the celestite beds are 10 to 15 feet thick and directly underlie the gypsum. The celestite is tilted here 70 degrees northerly.

Approximate estimates of tonnage of different materials contained in Avawatz Mountains, Sheep Creek, Jumbo Salt, Salt Basin, Valley Salt and West End areas:

SHEEP CREEK:	
Talc	400,000 tons
Gypsum	4,000,000 tons
JUMBO SALT AREA:	
Salt	9,000,000 tons
Gypsum	7,000,000 tons
SALT BASIN:	
Salt	8,000,000 tons
Gypsum	6,000,000 tons
Celestite	600,000 tons
VALLEY SALT:	
Salt	5,000,000 tons
WEST END:	
Gypsum of good quality.	4,000,000 tons
Large quantity of good celestite.	

'AGSTONE' AND ITS POSSIBILITIES IN CALIFORNIA.

By C. McK. Laizure.

Agstone is the name used by the trade to designate agricultural limestone, which is nothing more than raw limestone of more or less purity, in the form of screenings and meal, or finely pulverized, used for agricultural purposes as a soil sweetener, adjuster or corrective. It is sometimes referred to as a fertilizer, but there is lack of agreement as to whether or not it is a true fertilizer, in a strict sense.

Great interest has been aroused in the last few years in the use of agricultural limestone, and centered in the eastern United States there is a very active National Agricultural Limestone Association composed of producers of 'agstone.'

In January the annual convention of the association was held in Columbus, Ohio, and some interesting discussions regarding the use and need of agricultural limestone took place. Some notes are here given, taken from the report of the convention as it appeared in 'Rock Products,' Chicago, Illinois.

Four representatives of the Soils Department of Ohio State University made addresses. The general trend of their talk was that practically 90 per cent of all farm lands in the country needed agricultural limestone; that the farmer was slowly but surely finding out that agricultural limestone paid bigger and better dividends than any other investment he could make. Also that farmers using commercial fertilizer would get doube value from it, if it were used with agricultural limestone.

'Agstone' producers do not claim that their product is a cure for all ills found on a farm; there must be proper drainage, crop rotation and other practical methods used in farming in order to get the best results from the use of agricultural limestone.

Producers present at this convention agreed to furnish free 'agstone' for all demonstrations conducted by the Soils Department of the Ohio State University, provided these soil tests are made to determine how much limestone should be spread per acre to neutralize soil acidity. This action was taken in order to make sure that limestone is given a fair chance to prove its usefulness as a soil corrective and crop booster.

It was further brought out that the need and use of agricultural limestone is being discussed at many farm institutes, farm bureaus, granges and other rural meetings, and that the future for agricultural limestone looks brighter now than ever before.

The 'agstone' industry is no longer an infant. The product is now given a place under its own name on the commodity list of the Interstate Commerce Commission.

In many localities the 'agstone' idea is sold to the farmers 100 per cent, but vast areas of farming sections in the country are yet awaiting its message. It was the general belief that within a few years every successful farmer would look upon and use agricultural limestone as a part of his farming program.

Because of the interest shown in limestone by the Missouri farmers during the past two years, the Missouri State College of Agriculture found it necessary to secure data from every possible source to present the information requested. In this connection a moving picture film was secured that illustrated the practical needs for limestone.

For the year ending December 1, 1921, Missouri county reports showed 41,253 tons of limestone pulverized and applied to the soil, an increase of 125 per cent over the 1920 figures for the same counties. In certain other states of the 'corn belt' a few single counties used almost as much as the above figure for Missouri.

The total production of limestone in California for 1920, *not* including that used in cement manufacture nor lime for building purposes, but accounting for all that utilized as a smelter flux, for glass and sugar making and other chemical and manufacturing processes, including fertilizers, 'roofing gravel,' whiting for paint, kalsomine, terrazza, chicken grit and for CO_2 (carbon dioxide gas) was 90,120 tons. Of this total it is estimated that from 20,000 to 25,000 tons was agricultural limestone.

This estimate includes clam-shell marl used as a fertilizer and certainly indicates that there is room in this State for the 'agstone' industry to expand, if producers will apply 'selling methods' to dispose of their product and educate prospective users to a full realization of its benefits.

Under the heading, 'Growing need for lime on California soils,' 'Cement, Mill and Quarry,' Chicago, Illinois, says: ''The lime requirement of Northern California soils aggregates many millions of tons and the fertility of large areas not properly limed is seriously impaired, according to University of California experts. It is pointed out that the natural supply of lime has in the main been leached out of the soils by drainage and cultivation, and that the farmers have not been sufficiently awake to the necessity of replenishing the supply.

The loss of farming profits as a result of the condition can not be estimated, but students of the subject are convinced that it is serious. The excessive acidity of most of the soils hinders proper plant development and crop fruition, and the only way the condition can be corrected is by liberal application of lime. * * *.

A soil survey to determine the extent of soils suffering from excessive acidity is being made. From preliminary surveys it is stated that the principal loams of the interior are largely in a neutral condition, very low in humus and production vitality.

Liming to the extent of two or more tons an acre is recommended for the main body of these soils. Northward in the valleys the lime requirement increases and in the coast counties where the rainfall is heavier, the lime requirement is estimated at from 6 to 10 tons per acre.''

Analyses of agricultural limestone vary greatly, ranging from 98% calcium carbonate ($CaCO_3$) a very pure limestone, to as low as 54% $CaCO_3$ and 44% $MgCO_3$, the latter being a dolomitic limestone or dolomite which is a mixture of calcium and magnesium carbonates. The true mineral dolomite contains 45.65% $MgCO_3$. 'Agstone' in which neither the calcium carbonate, nor the combined calcium and magnesium carbonate contained, reach such a high percentage, is also produced but it is relatively less efficient for agricultural use.

Agricultural limestone shows a great variety in price from one end of the country to the other. The average price of 'agstone' in the United States was $2.75 per ton in 1921 or 25 cents higher than the 1920 price. The increase is accounted for by the fact that production of agricultural limestone was abnormally low in 1921, and also that agricultural limestone is more carefully prepared now than formerly, resulting in a greater production cost. The unusual variation in prices at different localities is due to variations in the fineness of the material.

Published quotations are on material varying from 75% through 200 mesh, to that which screen tests 50% through 4 mesh. Various percentages of intermediate degrees of fineness are also made and sold. In this connection it is well to note that the results that might be obtained by using limestone of different degrees of fineness, including screenings, was discussed by producers and soil experts at the Agricultural Limestone Convention referred to previously. The soil experts said that experiments are being carried on along these lines at the present time, but that finely pulverized limestone will give quicker results and neutralize soil acidity almost upon contact with the soil, though splendid results for money spent had also been obtained by the use of 'agstone' meal and screenings.

Prices as of March 11, 1922, ranged from $7.75 per ton at Alton, Illinois, for 'agstone' analyzing 96% $CaCO_3$, 0.3% $MgCO_3$ 90% through 100 mesh; to 50 cents per ton at Garnett, Oklahoma, for 'agstone' analyzing 86% $CaCO_3$, 50% through 4 mesh.

California quotations on the above date were:

Colton, California—Analysis 90.95% $CaCO_3$, 1-3% $MgCO_3$ all through 14 mesh, bulk $4 per ton.

Terminal California—Analysis 97.3% $CaCO_3$, .04% $MgCO_3$, 65% through 200 mesh, 90% through 100 mesh, 95% through 80 mesh, 100% through 50 mesh; sacks $5 per ton, bulk $4.50 per ton.

Reports of experiments on acid soils in many states prove that there can be no question of the benefit to be derived from using limestone, to mention but one of the natural mineral soil correctives or fertilizers, and one that occurs abundantly in this state. The Association of Natural Soil Fertility Resources has recently been organized, with headquarters in Chicago, for the purpose of promoting the use of mineral fertilizers, to study their use in cooperation with the agricultural experiment stations of the country, and to determine and enlarge the regions in which they can be economically supplied.

There is much evidence that limestone needs only to be pushed to increase its agricultural use many fold and that California offers a splendid field for development of the 'agstone' industry to the benefit of both the mining and agricultural interests.

High freight rates bear heavily on the sale of agricultural limestone; notwithstanding, shipments in the eastern states are made as far as 500 miles. In many of the states it has been possible to get reductions on 'agstone' rates, and there is little doubt but that if the proper representations were made by the agricultural interests and limestone producers of California to the Railroad Commission or to the railroads direct, a rate could be obtained that would enable the industry to expand enormously.

In a product of this kind the margin of profit per ton will necessarily be small. But if aggressive 'selling methods' are employed, and advantage is taken of the educational work of agricultural institutions that are teaching the farmer the advantage of using it, there is good reason to believe that quantity production, with corresponding satisfactory financial returns, will be required to fill the demand for 'agstone' that will ensue.

NOTES FROM OFFICE OF STATE SURVEYOR GENERAL, SACRAMENTO.

By W. S. Kingsbury, Surveyor General.

Minerals in lands owned by state now subject to lease.

Through the courtesy of Fletcher Hamilton, State Mineralogist, in endeavoring to cooperate with the various departments of the state government in securing the highest efficiency in public service and especially in stimulating the development of the mineral resources of the state to the mutual advantage of the people and the state government, space has been allotted in this publication to acquaint the public with the Mineral Leasing Bill, passed by the last legislature.

The Mineral Leasing Bill, being chapter 303, Statutes of California, 1921, provides that the minerals in all state-owned lands may be leased upon a reasonable royalty basis.

A copy of the bill, rules and regulations to carry out the provisions thereof, and a list of all vacant state school lands, consisting of approximately 800,000 acres, subject to the provisions of the bill, may be obtained from the State Surveyor General, Sacramento, California.

Leases may be secured to extract the minerals from the tide and submerged lands of the state lying below the line of high tide of the bays in the state and of the Pacific Ocean.

Lands below the waters of the navigable lakes and streams are also subject to the provisions of the bill.

PROGRESS REPORT ON PLACER GOLD INVESTIGATION.

By Chas. S. Haley.

The district covered during the past month is almost altogether embraced in San Bernardino County. The one exception is the Boquet Canyon district, Los Angeles County. This district apparently contains a little auriferous gravel, but of very low grade. The fact that it would be necessary to dump into agricultural territory and that water would be scarce and hard to get on the various properties make them of negligible commercial importance.

In the neighborhood of Randsburg, the Stringer district and the wash therefrom, running down towards St. Elmo, is now being worked in a small way with hand dry washers, by two Italians. In my opinion, they are working it by the only feasible method. Like the deposits mentioned last month, on the Colorado River, these are extremely spotty, and the average tenor is quite low. Water is prohibitive in cost.

The fact that these deposits are mostly laid down by torrential action of cloud bursts in the gulch makes them even more spotty than the average.

At Summit, about six miles north of Randsburg, there is an area of disintegrated schist, containing quartz stringers, which furnishes a dry placer of considerable extent. Water can be brought on it from a distance of about twelve miles, but the same spotty character noted in the Stringer district makes it to my mind, extremely inadvisable to do so.

There is an ancient channel north of Barstow coming down from Long Range, through Coolgardie, which was extensively worked 30 or 40 years ago, by hand methods. Apparently, the gulches which cross this channel furnish sufficient concentration to pay fairly good wages, but this concentration is entirely worked out, and the main body of gravel will not justify the expense of exploitation. Water would have to be brought at least 15 miles to cover this property.

In Lytle Creek, along the line of the Santa Fe Railroad, there was considerable work done some forty years ago. The area is mostly disintegrated granite and schist, containing quartz stringers, and where the gulches afforded sufficient concentration, it is reported that good wages were made.

This district is also of little interest to the prospective investor in gravel.

NEW REPORT ON THE MOTHER LODE DISTRICT.

By C. A. Logan.

A great deal has been learned in the past 70 years about the Mother Lode quartz mines, at the expense of large sums of money and much time, that is not available today for the use of those who are looking for profitable employment of their money in mining. In many cases, the lack of this knowledge is a very real detriment to the development of promising areas. Much of this experience has been lost to the present generation by the dissolution of mining companies, by the death of men who worked in the mines, by fires, and by what may be termed hoarding on the part of a few companies and engineers, who mistakenly look upon the activities of some public agencies as encroachments on the field of private practice. This latter attitude is unprofitable, both to the individual and to the community. Certain it is, that the life of mining, here as elsewhere, depends on reliable publicity, the spirit of adventure, and the willingness to dig deeper; the last of which, translated to date, means larger sums for prospecting and development than have been needed heretofore. But the man who digs needs to know all there is available regarding the past history of the camp, in order that he may dig with the greatest possible chances of success. If he succeeds, the spirit of adventure awakens in others, and the breath of life remains in the camp; if he fails, as he does quite often, from the lack of sufficient knowledge of the problem at hand, much more is lost to the community than the money he has spent. If an ore shoot has been bottomed, it is better that the fact be known so that the operator may have an idea of the odds before unwatering the mine. If your neighbor has a promising claim, and you have not enough money to buy it, it is sound business to boost it whether you think the ore shoot pitches into your ground or not; if his ground develops into a mine yours will certainly receive attention and may at least make a good mill site or tailing pond.

It may be thought unfortunate that under present conditions most of the money available for mining is in the hands of conservative companies who endeavor to lessen the inevitable chances of mining by demanding such things as assay plans and bullion receipts. The average prospector, could he afford the one or secure the other, would naturally feel beyond the need of searching for a buyer. With the facts as they are, however, it behooves him to dig intelligently and with full knowledge of what has been done by those who were there before him. It may be well to state here that the writer classes also as prospectors most of the small companies or partnerships who have operated along the north and south ends of the Mother Lode in the past. There are still long distances that have never been adequately prospected by properly financed companies. The ultimate purpose of the prospector should be to develop his property to the point where it will appeal to the large companies, if he is working on the Mother Lode; in the case of smaller and richer veins this does not apply with such force. Capital should be devoted almost entirely to underground work to show the size and tenor of ore bodies, with expenditures for mills limited to the amount needed for preliminary tests of the ore. With a proven ore body, it is easier to finance mill building, than it is to get extra money for underground work, after prematurely erecting plants.

There has been no comprehensive report published on the Mother Lode during the last eight years, although many important developments have gone on in Amador, Calaveras and Tuolumne counties which have proven the possibilities of the belt in depth. There have been no comprehensive maps or geologic studies of the Lode in the past 20 years, and such as were previously made are scattered in publications that are out of print and not available for general use. Much valuable information on the subject is buried in the files of idle companies, mine owners, mining engineers and surveyors. If this can be collected under one cover, and brought up to date by investigations of accessible mines, it is believed it will prove of great benfit.

These considerations have led Fletcher Hamilton, State Mineralogist, to direct the writer to prepare a new report on the Mother Lode. It is hoped to include in this, adequate maps, plans and sections of mine workings, details of underground operations and production, and pertinent information on geology and mineralogy. For much of this we must depend on the friendly help of owners and engineers, whose life work has put them in possession of much data that will be helpful to themselves and the districts in which they are interested, if these can be made available to the public.

Working from the Auburn office, the writer has already accomplished a good deal on the report, and plans to cover the Lode in detail during the coming spring and summer.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Summary of Operations California Oil Fields, December 1921, Vol. 7, No. 6.

Mining in California, February, 1922, (Monthly) Vol. 18, No. 2.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications distributed during the month of March, 1922.

Publications.	Number Distributed.
Report XV State Mineralogist	2
Report XVII State Mineralogist	24
Mines and Mineral Resources of Del Norte, etc.	3
Mines and Mineral Resources, of Fresno, etc.	1
Mines and Mineral Resources of Imperial, etc.	1
Mines and Mineral Resources of Alpine, etc.	1
Mines and Mineral Resources of Butte, etc.	2
Mines and Mineral Resources of El Dorado, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	1

Publications	Number Distributed
Mines and Mineral Resources of Monterey, etc.	2
Mines and Mineral Resources of San Bernardino, etc.	3
Mines and Mineral Resources of Nevada County	5
Mines and Mineral Resources of Plumas County	4
Mines and Mineral Resources of Sierra County	10
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	4
Bulletin No. 67, Minerals of California	2
Bulletin No. 72, Geologic Formations of California	5
Bulletin No. 75, Mining Laws, United States and California	25
Bulletin No. 76, Manganese and Chromium in California	2
Bulletin No. 78, Quicksilver Resources of California	5
Bulletin No. 85, Platinum Resources of California	7
Bulletin No. 89, Petroleum Resources of California	340
Bulletin No. 90, California Mineral Production for 1920	25
Preliminary Report No. 3, Manganese and Chromium	1
Preliminary Report No. 4, Tungsten, Molybdenum and Vanadium	1
Preliminary Report No. 5, Antimony, Graphite, Nickel, Potash, Strontium and Tin	1
Preliminary Report No. 6, Review of Mining in California during 1919	1
Preliminary Report No. 8, Review of Mining in California during 1921	664
Mining in California, Monthly Chapter Report XVIII, January, 1922	735
County Maps and Registers of Mines	1
Shasta County Forest Map	4
Sierra County Forest Map	6
Siskiyou County Forest Map	1
Desert Region Map	4
Inyo County Geological Map	1
Minaret District Map	2
Forest Map, Mounted	1
Geological Map of California, Mounted	10
Plumas County Mineral Map	1
Oil Field Maps	318

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 1085 letters were received and answered. They are practically all requests for information, and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up to date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

Statistics.

There are several thousand individual producers of mineral products in California, and the task of compiling accurate and dependable statistics covering their activities is an extremely difficult one.

The Bureau's data is authoritative, all figures, with the exception of those for gold and silver which are supplied through the courtesy of the United States Geological Survey, being obtained by direct communication with the producers.

Since the inauguration of the Monthly Chapter it is possible to publish the production figures for any mineral within a maximum period of thirty days from the date on which the returns are complete.

It is hoped that the early appearance of the figures for some of the minerals will induce other producers to cooperate, to the end that the complete statistical bulletin may be incorporated in one of the early mid-year issues of the Chapter. Blank forms were sent out in January, for the 1921 data, and a second request was mailed the second week in March to those from whom no reply had come in. We shall doubtless be in a position to give the figures for some minerals in the April issue of 'Mining in California.'

The dissemination of data on the consumption of mineral products in California, figures for which are rarely obtainable, is a new feature to be forthcoming. This state can easily supply its own needs in many lines, if the consumer will only realize the extent of the natural resources within our own borders. Much material is shipped in here from points outside of California that could be supplied from local sources, and in many cases of equal quality.

Museum.

Each issue of the Monthly Chapter will contain a brief account of current museum activities. This will include a list of new acquisitions received with names of donors, a report of the number of visitors registered, and other items tending to keep the public advised of the advantages, from an educational standpoint, afforded by the exceptionally fine collection of rocks and minerals of both economic and academic value, comprising the 16,000 specimens on exhibit. The Museum contains not only one or more samples of most of the known minerals found in California, but hundreds of specimens from other states and foreign countries as well. An account of the arrangement and classification of specimens in this collection will be given in an early issue of 'Mining in California.'

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

Among the specimens received recently, and catalogued, for the Museum are the following:

19541. *Cadmium* (metallic). Recovered at copper smelter by electrolytic treatment of bag-house fume for zinc and cadmium. From Mammoth Plant, Shasta County, Cal., by U. S. Smelting, Refining and Mining Co., San Francisco, Cal.

19542 to 19550 Inclusive. *Cerrusite* (lead carbonate), *Galena* (lead sulphide) and *Pyrrhotite* (magnetic pyrites), *Anglesite* (lead sulphate) and *Galena* (lead sulphide), *Anglesite* and *Cerrusite* (lead sulphate and carbonate respectively), *Anglesite* (lead sulphate), *Pyrrhotite* (magnetic iron sulphide, with *Galena* and *Sphalerite*), *Smithsonite* (zinc carbonate), *Pyrargyrite* (silver antimonial sulphide, dark 'ruby silver ore'). From El Potosi mine, Santa Eulalia District, Chihuahua, Mexico, by W. B. Tucker, Redding, Cal.

19551. *Sphalerite* (zinc sulphide). From Calera mine, Guerrero District, Chihuahua, Mexico, by W. B. Tucker, Redding, Cal.

19552 to 19555 Inclusive. *Patronite* (vanadium sulphide), *Hewetite* (hydrous calcium vanadate; an oxidation product from Patronite), Ferro-Vanadium alloy stated to contain 60% V, smelted from ores of American Vanadium Co. mine; *Quisqueite* (mainly C and S, with a small per cent of V) associated with *Patronite.* From American Vanadium Company mine, Peru, by R. A. Grigsby, San Francisco, California.

19556. *Gold* ore, carrying *Tellurides* and Sulphides in Quartz. From Liberty Bond mine, near Confidence, Tuolumne County, Cal., by Chas. G. Dowd, Tuolumne, California.

19557. *Cinnabar* (mercuric sulphide, massive, high-grade). From Almaden mine, Spain, by Henry W. Gould, San Francisco, Cal.

19558. *Cinnabar* (mercuric sulphide, with calcite). From Abadia San Salvatore, Monte Amiata, Tuscany, Italy, by Henry W. Gould, San Francisco, Cal.

19559. Cinnabar (*Mercuric Sulphide*), From Idria, Carniola, Italy (formerly Austria), by Henry W. Gould, San Francisco, Cal.

19560. *Diatomaceous Earth* (fine quality, white). From Shasta County, by Read McCraney, Oakland, Cal.

19561. *Cinnabar* (mercuric sulphide). From Goose Lake Quicksilver mine, Modoc County, Cal., by Goose Lake Mining Co., Willow Ranch, Cal.

19562. *Diatomaceous Earth.* From near Hazen, northern Churchill County, Nevada, by Alice M. Southworth, San Francisco, Cal.

19563 and 19564. *Thenardite* (anhydrous sodium sulphate; crystals including one especially-fine, large twin). *Potash*-bearing salt, from solid bed in Service Well No. 2. From Deep Springs Valley, Inyo County, Cal. (Inyo Chemical Co.), by C. E. Dolbear, San Francisco, Cal.

19565. *Tungstenite* (tungsten sulphide). From Emma mine, Cottonwood District, Utah. Loaned by Walter W. Bradley, San Francisco, Cal.

19566. *Orthoclase Feldspar* (potassium-alumimum silicate, high-grade). From Elder mine, near Campo, San Diego County, Cal., by George W. Elder, San Francisco, Cal.

19567. *Magnesite* (magnesium carbonate). From Quaker Group, near Cima, San Bernardino County, Cal., by George W. Elder, San Francisco, Cal.

19568. *Sulphur* (native) (with occasional specks of Cinnabar). From Full Moon Group, Imperial County, Cal., by A. G. Tingman, Encinitas, Cal.

19569. *Chloropal* (hydrated iron silicate). From near Alturas, Modoc County, Cal., by Kelley Bros., Alturas, Cal.

19570. *Colemanite* (calcium borate). From Great Western Chemical Company property, Clark County, Nevada (new F. M. Smith discovery), by Joseph L. Joseph, San Francisco, Cal.

19571 and 19572. *Dendritic Opal*, and *Magnesium Silicate.* From San Francisco County, Cal., by C. Mareau, San Francisco, Cal.

19573. *Scheelite* (calcium tungstate). From near Jamestown, Tuolumne County, Cal., by Peter Mackay, Jamestown, Cal.

19574. *Calcium Carbonate* (minute hollow tubes, replacement of some form of grass or small reeds.) From near Pyramid Lake, Nevada, by Tom Massey, Susanville, Cal.

19575. *Magnesite* (magnesium carbonate). A natural 'ferro-magnesite', containing iron oxide, and utilized (after being dead burned) for refractory furnace lining. From White Rock mine, Napa County, Cal., by Frank R. Sweasey, San Francisco, California.

19576. Free *Gold* in Hematite. From Apache mine, El Fuerte District, Sinaloa, Mexico, by E. L. Vander Naillen, Oakland, Cal.

19577. Free *Gold* in Hematite. From Bishop mine, El Fuerte District, Sinaloa, Mexico, by E. L. Vander Naillen, Oakland, Cal.

19578. *Chalcocite* (cuprous sulphide, copper glance) with high silver values. From Calabacias mine, Batopilas, Chihuahua, Mexico, by E. L. Vander Naillen, Oakland, Cal.

19579. *Chalcocite* (cuprous sulphide, copper glance) with high silver values. From Morelos mine, Morelos District, Chihuahua, Mexico, by E. L. Vander Naillen, Oakland, Cal.

19580. *Galena* (lead sulphide, argentiferous, silver-bearing). From Dura mine, Morelos District, Chihuahua, Mexico, by E. L. Vander Naillen, Oakland, Cal.

During the month a total of 385 visitors signed their names on the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

The question arising as to the important constituents of an unusual or interesting-looking rock and as to its possible commercial value are usually quickly answered for the prospector and those who are interested in the subject.

The prospector should realize that the importance of the non-metallic minerals is continually increasing and that it is possible to find over fifty minerals of commercial value in the state. For this reason care should be taken to have any rock identified that appears to be different than the ordinary country rock.

Ordinarily a small sample weighing not over a pound is required in making a determination; but it should be in the unground, lump form. When the precious metals, gold, silver, platinum, etc., are suspected, larger samples should be submitted. The size of the deposit is often of importance in determining the commercial value of a mineral and when possible, a statement regarding the extent of the orebody should be made. For instance, a good grade of limestone free from magnesia would probably mean little if the deposit was small, but if the deposit should be extremely large and not far from transportation it is possible that it could be used in the making of cement.

The importance to the miner and prospector in being able to identify platinum was recently brought to light in this laboratory. It was suggested to the operator of a placer mine in Placer County that he bring in some of the concentrates after all the gold had been removed and that an examination be made for platinum. The sample submitted was found to contain considerable platinum. Previously the presence of platinum in the channel was not known by the present operators.

There are no convenient field tests for determining the presence of platinum. The prospector or miner should attempt to gain some actual experience in panning platinum-bearing sand. At the San Francisco laboratory assistance will be given in the identification of platinum, by panning, to any prospector.

During the thirty-day period covered by this report climatic conditions throughout the state were not generally favorable for prospecting; however, 203 samples were received for identification and assistance was given to 6 visitors who had some special problem they wished to have worked out in the laboratory.

Of the minerals interesting in an academic way in addition to the possible commercial value, a sample of troilite from near Crescent City, Del Norte County, was received. Troilite is a simple sulphide of iron (FeS) resembling the artificial sulphide of iron used for technical purposes. Troilite is soluble in sulphuric acid, differing in this respect from both pyrite (FeS_2) and pyrrhotite (Fe_nS) which are insoluble in that acid. Troilite has previously been identified only in meteorites. In this Del Norte County occurrence, some magentite is associated.

A list of the minerals of possible value, judged from the sample submitted only is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05– 78	Talc—schist.
05– 79	Hematite—paint pigment.
05– 80	Lepidolite; also sulphur.
05– 81	Copper.
05– 82	Troilite—contains some magnetite.
05– 83	Gypsum; also clay.
05– 84	Asbestos—amphibole variety.
05– 85	Galena—some silver and gold present.
05– 86	Lead Carbonate—contains some silver.
05– 87	Aluminum phosphate (turquoise).
05– 88	Platinum and platinum group metals.
05– 89	Gold quartz.
05– 90	Gypsum; also impure sodium sulphate.
05– 91	Molybdenite; in granitic rock.
05– 92	Limestone (possibly lithographic).
05– 93	Sodium carbonate.
05– 94	Asbestos—short fiber crysotile.
05– 95	Nitrate of sodium and potassium.
05– 96	Mica—biotite variety.
05– 97	Clay.
05– 98	Lime carbonate, very pure.
05– 99	Lignite, good grade.
05–100	Fluorite.
05–101	Copper ore—azurite and malachite; also sphalerite.
05–102	Platinum and platinum group metals.
05–103	Sulphur—contains some cinnabar.
05–104	Galena—some silver and gold present.

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey Bulletin No. 726-G; The Lacasa Area, Ranger District, North Central Texas, by Clarence S. Ross.

U. S. Geological Survey Bulletin No. 735-B; Colemanite in Clark County, Nevada, by L. F. Noble; Salt, Bromine and Calcium Chloride in 1920, by Ralph W. Stone.

U. S. Bureau of Mines, Reports of Investigation:
- Serial No. 2306; Momentary Heating of Inflammable Coal Dusts, by Guy B. Taylor (Chemist), Horace C. Porter (Chemist), and E. C. White (Junior Physical Chemist).
- Serial No. 2307; Silica, by Raymond B. Ladoo (Mineral Technologist, Bureau of Mines).
- Serial No. 2308; Safety of Mine-Type Telephones, by L. C. Lisley (Electrical Engineer, Bureau of Mines).
- Serial No. 2309; Compressed-Air Blowers as an Aid to Metal-Mine Ventilation, by Richard V. Ageton (Metal-mining engineer, U. S. B. M.).
- Serial No. 2310; Growing Need for Preservation of Mine Timber, by H. R. Hornor, (Mining Engineer U. S. B. M.).
- Serial No. 2311; Conditions in the Feldspar Industry, by Raymond B. Ladoo (Mineral Technologist, U. S. B. M.).
- Serial No. 2312; Low Temperature Distillation of Amalgams of Bituminous Non-Coking Coal and Asphaltic Oils, by Joseph D. Davis (Asst. Supervising Chemist, Pittsburgh Experiment Station, B. M.), and C. E. Coleman (Junior Chemist, Pittsburgh Experiment Station, B. M.).

OFFICIAL PUBLICATIONS RECEIVED, *Governmental*—Continued.

Serial No. 2313; Solubility of Oil Shales in Solvents for Petroleum, by Martin J. Gavin (Oil-shale Technologist, U. S. B. M.) and John T. Aydelotte (Organic Chemist, Colorado Cooperative Oil-Shale Investigation.)

Serial No. 2314; Milling Methods in the Tri-State Zinc District, by Will H. Coghill (Metallurgist, U. S. B. M.), and C. O. Anderson (Metallurgist, U. S. B. M.).

Serial No. 2315; Placer Mining Methods.

Serial No. 2316; Subject List of Reports of Investigation.

Serial No. 2317; Recent Articles on Petroleum and Allied Substances, by E. H. Burroughs (Bibliographer, B. M.).

U. S. Department of Commerce Reports; A Weekly Survey of Foreign Trade.

Kentucky Geological Survey; Series VI, Vol. VI, by Willard Rouse Jillson.

North Carolina Geological and Economic Survey; Economic Paper No. 51, Forest Fires of North Carolina During 1918–1920.

Bureau of Topographic and Geological Survey, Commonwealth of Pennsylvania:

Bulletin No. 1; Effect of the War on the Price of Coal in Pennsylvania, by George H. Ashley.

Bulletin No. 2; Oil and Gas in Southeast Pennsylvania, by George H. Ashley.

Bulletin No. 3; Development and Probable Life of Gas Pool at McKee's Port, Pennsylvania, by George H. Ashley.

Bulletin No. 4; Decline of McKee's Port Gas Pool, by George H. Ashley.

Bulletin No. 7; A High-Grade Building Stone in Greene County, by George H. Ashley.

Bulletin No. 14; Future Sources of Power, by George H. Ashley.

Bulletin No. 16; Geology of Oil and Gas in Relation to Coal, by George H. Ashley.

Bulletin No. 23; Coal Beds in Cambria County, Pennsylvania, by J. D. Sisler.

Bulletin No. 24; Coal Beds in Greene County, Pennsylvania, by J. D. Sisler.

Bulletin No. 25; Coal Reserves in Greene County, Pennsylvania, by John F. Reese.

Washington Geological Survey:

Bulletin No. 21; Mineral Resources of Washington with Statistics for 1919, by Ernest N. Patty, and Sheldon L. Glover.

Bulletin No. 23; The Metal Mines of Washington, by Ernest N. Patty.

Bulletin No. 25; The Magnesite Deposits of Washington, Their Occurrence and Technology, by George E. Whitwell and Ernest N. Patty.

Geological Survey of Canada; Memoir No. 127, Beauceville Map Area, Quebec, by B. R. MacKay.

Geological Survey of Canada; Memoir No. 128, Winnipegosis and Upper Whitemouth River Areas, Manitoba Pleistocene and Recent Deposits, by W. A. Johnston.

Report of the Department of Mines for the Fiscal Year Ending March 31, 1921; Ottawa, Canada.

Preliminary Statement on the Mineral Production, Province of Quebec; Feb. 1922.

Mineral Production of Ontario in 1920.

Director of Mines and Government Geologist, Adelaide, South Australia; Annua Report for 1920.

Anales Del Congreso Nacional de la Industria Minera; Lima, Peru.

Boletin Minero; Organo Del Departamento de Minas, Mexico, Tomo XII, Numeros IV and V.

Societies and educational institutions.

American Mining Congress Journal, March, 1922.

Mining and Metallurgy, January and February, 1922.

Journal of Geology, January and February, 1922.

Economic Geology, January and February, 1922.

Bulletin of the Institution of Mining and Metallurgy, February, 1922.

American Mineralogist, January, 1922.

Proceedings of the Engineers' Society of Western Pennsylvania.

Bulletin of the Canadian Institute of Mining and Metallurgy, March, 1922.

Del Cuerpo de Ingenieros de Minas Del Peru; Boletin No. 101, Lima, Peru.

Colorado School of Mines; Quarterly Catalog Edition.

OFFICIAL PUBLICATIONS RECEIVED,

Societies and Educational Institutions—Continued.

Colorado College Publication; General Series No. 109, Juan Ramon Molina, by J. William Chaney, A. M.

General Series No. 110, Syllabus on American History and the Natural Sciences, by Archer Butler Hulbert.

Books.

The Mineral Industry, 1920.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Scientific Press, San Francisco.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor. Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral products or deposits for which a market is sought.

02–47 Turquoise.
02–48 Diatomaceous earth deposit—or party who will develop.
02–49 Gold mine—8 patented claims in Riverside County.
02–50 Silica deposit—8 patented claims in Riverside County.
02–51 Silver mine—80 acres, in Orange County.
02–52 Feldspar deposit—approximately 200 acres, Riverside County.
02–53 Oil Shale.
02–54 Fuller's Earth.
02–55 Clay—suitable for pottery, brick, tile, etc., 40 acres.
02–56 Limestone deposits—in Imperial, Orange, San Bernardino and Kern Counties.
02–57 Feldspar deposits—high potash content, in San Diego and Imperial Counties.
02–58 Gold prospect—South Fork Feather River, Butte County; or capital assistance.
02–59 Gold mine—Cargo Muchacho district, Imperial County.
02–60 Gypsum deposit—high grade. 80 acres, Imperial County.
02–61 Gold mine—Production 1895 to 1900, $75,000.
02–62 Limestone deposit—Inyo County.
02–63 Plastic clay—Sec. 3, T. 6 S., R. 7 W.
02–64 Soda deposits—San Luis Obispo County.

Mineral products or deposits wanted.

03–37 Small gold property—to lease, or lease and bond.
03–38 Bentonite.
03–39 Limestone—near Los Angeles, suitable for structural purposes.
03–40 Sandy loam—without iron, vicinity of San Francisco Bay Counties.
03–41 Scheelite—minimum 65% W O_3, free from tin and copper. Want 25 to 30 tons monthly for one year, beginning in July.
03–42 Feldspar—also white-burning clay.
03–43 Placer property.
03–44 Soapstone—that can be cut into 4-inch blocks, and has some crushing strength.
03–45 Kaolin—or white-burning or white-grinding clay.
03–46 Clay—white-burning.
03–47 Magnesite—tonnage.
03–48 Iron ore (for paint); chalk and white barytes.
03–49 Gold property, small—lease or bond; can handle refractory ore.

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–6 Metallurgist. One year operator experimental plant; six years as metallurgist with large companies. Age 29. Married. References.

01–7 Mine or mill superintendent or foreman. Fourteen years experience mine and mill operation. Age 36. Married. References.

01–8 Assayer or analytical chemist. Six years experience as assayer and chemist, copper company. One year analytical chemist, U. S. Navy. Age 29. Single. Salary wanted, $125. References.

APRIL, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by dstrict engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. TUCKER, Mining Engineer.

Shasta County.

The *Double Header Mine,* situated near Tower House, has been relocated by Charles Garrett of Tower House. A 400-foot tunnel has been cleaned out and retimbered. A vein of heavy sulphide ore is reported to have been discovered in the tunnel, and is stated to carry high values in gold.

The *Shasta Hills Mining Company,* who are operating the *Sybel Mine* in the French Gulch district, have five stamps running on excellent ore, and recent development work has opened up new ground yielding good results.

The *Washington Development Company* of Oakland, California, who are operating the *Washington Mine* in the French Gulch district, have developed some very good ore in the upper workings of this property. On April 8th the five-stamp mill was placed in operation, and sufficient ore has been broken in the stopes to keep the mill under continuous operation. The different tunnel levels have been cleaned out and retimbered, and an active prospecting campaign is under way by the company in the hope of developing some new ore bodies. Fifteen men are employed. G. T. Salisbury, general manager.

The *Balaklala Mine* at Coram is reported to have been leased by the *United States Smelting, Refining and Mining Company,* owners of the Mammoth smelter.

A number of men have been placed on development work at the *Little Nellie Mine,* which is situated southeast of Iron Mountain. The property is owned by the *Pittsburgh and Mount Shasta Mining Company* of Pittsburgh, Pennsylvania. T. V. Scott is managing director of the company.

Siskiyou County.

The *Spring Mine,* situated on Humbug Mountain, near Hawkinsville, is being reopened by Clyde and Ben Fairchild of Yreka. They purpose to drive a lower tunnel, about fifty feet below the present workings, to cut the vein at a greater depth.

The *Keynote Mine,* recently discovered by Horace Howe of Yreka, is located 6 miles north of Yreka. The property has been recently bonded to N. R. Randall of Seattle, who has a force of men developing the property.

The *Cub Bear Mine,* southeast of Etna Mills, is being operated by the Siskiyou Syndicate. An active campaign of development work is under way under the supervision of J. W. Applegram, superintendent.

Trinity County.

The *Lewiston Gold Dredging Company* has purchased the Martin placer ground, on the Trinity River above Lewiston. This company has bought the *Valdor Dredging Company's* dredge, which is being dismantled, and the material and machinery will be transported to the holdings of the Lewiston Gold Dredging Company. It is expected that the new dredge will be in operation late this fall.

There is considerable stir in the mining of platinum on Hayfork Creek in the neighborhood of Wildwood. It is reported that a large number of claims have been located in this region.

AUBURN FIELD DIVISION.

C. A. Logan, Mining Engineer.

Nevada County.

Alcalde Mine. This property is about four miles southwest of Grass Valley and has been variously known in the past as the Bowery, Seven Thirty or Kenosha. Since our last report, underground work has continued with a small crew. At present five men are employed.

The south drift on the 400 level is being driven ahead and is now 960 feet long. (April 7.) For a length of 125 feet on this level the vein is reported 2 to 3 inches wide, carrying free gold, and this is thought to be on the McCook shoot; the Bowery shoot is looked for 100 feet ahead. Present plans contemplate raising for a new shaft soon after cutting the latter shoot, as the shoots are pitching away to the south from the present shaft. A winze has been put down 56 feet from the 400 level at a point 400 feet south of the shaft. The mill was last run for 20 hours on Oct. 9, 1921. Since the last report a little ore in small bunches has been stoped by lessees on the 300 level.

Alta California Gravel Mine, I. Haas, 2299 Sacramento St., San Francisco, and I. Stein, owners. This mine, on a branch of the Alta Hill channel between Grass Valley and Rough and Ready, has been worked lately under lease and bond by Chas. Gurden, with three men employed; but Gurden quit work about the end of March and has taken out the rails and other equipment.

Alta Combination Mine. This ground continues in process of prospecting with only a few men employed. It takes its name from the fact that the operators hope to develop both quartz veins and gravel. To date no important developments have been made. H. L. Ostrander is manager. The property is near Rough and Ready.

Dull Mine is a new development near Newtown. On April 8 it was reported that work had been temporarily suspended pending additional financing by Dull, of Los Angeles, who is in charge.

Empire Mine continues as one of the two principal producers of the Grass Valley Camp.

Idaho Maryland Mines Co., J. A. Fulton, general manager. This company is continuing exploratory work with a crew of about 100 men. At the time they took the property it was reported that some of the old stopes in the Eureka were filled with ore worth about $10 a ton, and during the first year a lot of time was spent in reopening these old workings; but the manager states that the results of this work were disappointing.

To the end of 1921 there was open and accessible 25,448 feet of underground work in the mines, including 16,368 feet of drifts, of which 1478 feet was new drifting. The old Canyon Shaft (winze), which was sunk 350 feet from the Idaho Shaft, is 2109 feet vertically below the collar of the Idaho Shaft at 2000 level. Since Jan. 1, 1922, this Canyon Shaft has been put down and the 2100 level is being opened. For the first 300 or 400 feet this winze is in serpentine, but the rest of it is in hard rock and was found to be in much better condition than had been expected. On No. 16 level, 2000 feet east of shaft, the Dorsey winze goes down 500 feet. Work eastward on the vein is going on from the bottom of this winze. When the bottom of the winze was reached it was found to contain a little good ore, as had been stated by witnesses who had visited the mine just prior to the last shut-down, but Mr. Fulton reports that this was not in important quantity. Going eastward from there, the diabase becomes more massive and the vein, instead of being on the footwall of it, has been found to enter the diabase. The mineralization here has not been so positive, and so far as opened, for a distance of about 300 feet, the vein has not proven of good grade, according to Mr. Fulton. If ore is developed in this region, the management plans tentatively on the extension of the 2000 level from the Canyon Shaft to connect the Dorsey Winze with the Idaho Shaft, which is the present working entry.

North Star Mines Co. That gold mining conditions are still far from normal is shown by the report of this company for the year 1921. The North Star Mine maintained its former record of a gross output of about $1,000,000 a year, in spite of the fact that during the first half of the year operations were at only one-half capacity. This was done by mining and milling during the first half year selected ore of much higher than the average grade, and at an advance in cost of $3 or more a ton, due to overhead and fixed costs. This practice of taking out selected ore could not have been continued, according to A. B. Foote, general superintendent, without ruining the mine.

In July, operations were suspended for several weeks, pending an agreement on a reduced wage scale, without which it is understood the company would have been forced to close the mine entirely. Work at full capacity was not resumed until the end of October. The figures for average value of ore treated and average costs under such conditions would of course be entirely misleading, and are therefore not quoted.

It does not appear to be practicable to work the property on a reduced scale. During the last half of 1920, while running only 20 stamps, the cost of operation and development is said to have reached $13.38 a ton. During the first half of 1921 work at one-half capacity cost $11.60 a ton. Mining ore of such average grade as this mine has turned out for several years past, there would have been a substantial loss with the above costs. Operation at full capacity seems the best policy. This results in the plant and mine being kept in shape, the organization is held intact, and employment is given to a large crew at a time of general depression. At the same time, by spreading fixed charges over the largest possible tonnage, a small return on the investment is possible. However, development work is said to have been lagging at this mine in the past few years, as at many other gold quartz mines, on account of adverse conditions.

During 1921 there were 99,945 tons hoisted from various levels between the 3100 and 6000. Of this amount, 23,945 tons were sorted out as waste and 76,000 tons were milled. Of the total recovery, 86.08 per cent was saved by amalgamation and there was a tailing loss of 26 cents a ton. Reduction of cost amounting to about $1.10 a ton mined is attributed to decreases during the last half of 1921 in the cost of labor and explosives. Pumping is said to cost about 36 cents a ton and hoisting about the same. Some striking figures are cited in regard to taxes paid. The company paid last year a total tax of $25,542 on an assessed valuation of $551,835. With the mine working at full capacity, Mr. Foote estimates that the total of all taxes paid is equal to 38 cents per ton of ore treated, as compared with 25 cents in 1914. With the mine and mill in full operation he estimates present cost at about $8 a ton, as compared with a total cost of $7.20 a ton estimated for the year 1918 and $4.94 per ton for 1914.

Normandy Mining Co. (formerly called *Normandie Dulmaine*). This prospect is 4¾ miles from Grass Valley and near the Alcalde Mine. A. B. Greenwald, secretary, Grass Valley. The shaft had reached a depth of 250 feet on April 7, and it is planned to continue sinking to 500 feet. About 80 feet of drifting has been done at a depth of 130 feet.

The vein stands nearly vertical in amphibolite schist walls. The fissure is about the width of the shaft, and the quartz vein runs from a foot to a foot and a half wide, having the latter width in the bottom of the shaft. The width of the formation varies with the rolling of the hanging wall. The quartz is white, showing good-looking sulphides in small amount as a rule. It is said to assay well all the way down the shaft.

A crew of 14 men are employed three shifts in shaft sinking. The plant consists of a 5-stamp mill, 10-inch by 10-inch compressor, 25 h. p. motor, single drum hoist good for about 500 feet depth, and 15 h. p. motor.

The *Osceola Mine* is near Rough and Ready and has been described in our previous reports. Allen and Joseph Archibald have been doing some work lately on the property, and efforts are now being made to finance further operations.

Penn-California Mining Co., Arthur Hoge, manager, Nevada City. This company's prospect adit on their claims near Willow Valley is now (April 15) 2800 feet long. Five raises, including one now going up near the face, have been driven in search of the main Harmony Channel, which the operators think crosses the property. One raise about 1100 feet in, broke into old workings on a small channel which was mined years ago by other owners. The present company has done considerable work on this channel; their main adit is about 20 feet below it, which will permit of going quite a distance downstream on it before running out of grade.

At present the main adit is 510 feet under the surface at the face and is said to be under the crest of the ridge. Raises have been 300 feet or more apart, beginning at 1100 feet in. Of the main adit, 2200 feet is in granodiorite and 600 feet in slate. Hoge states the total cost per foot, including overhead, taxes, pipe, rails, etc., has been $18.

Nearly parallel to the course of the adit are the Lone Star and Buckeye quartz veins, which outcrop on claims held by the same company. Farther downstream, quartz boulders carrying gold were common in the gravel mines on the Harmony Channel, and Mr. Hoge and others believe that these boulders were brought down by the ancient stream from its crossing with the veins named.

Randolph Consolidated Gold Mining Co., H. L. Ostrander, manager. This company has been shut down about a month pending the raising of funds for further work. There is a shaft on the vein about 100 feet deep, dipping 35 degrees west. It is on the Wm. Grant ranch, beside the Grass Valley road, near Rough and Ready. For the last 40 feet in the shaft, which was full of water when visited, the vein is said to be about 2 feet wide, according to Grant, the owner. A drift was just started at 100 feet when they quit work.

The equipment consists of 6 h. p. gas engine, hoist, ½-ton skip, and jack-head pump operated by 2½ h. p. gas engine.

Sultana Mine, Albert Crase, superintendent. Comparatively little work has been done in this mine since the Bureau's last detailed report. At present practically nothing but pumping is going on. The property has been examined by a number of engineers during the past two years.

The claims cover about two miles on the strike of the vein system, and the shaft in use at present is near the north end and not far from the Empire line. This shaft is 800 feet deep; thence a drift was run north 400 feet and a cross-cut driven 322 feet into the hanging-wall, then a winze was sunk to 2100 level. This work is all in diabase, but Crase is of the opinion that the 2100 level shows indications of being near the contact with the granodiorite.

Ore is reported on levels 3, 5, 12, 14, 15 and 19, the vein varying in width from a few inches to three feet. Several levels have been driven to the Empire line on the north, which is about 200 feet from the winze. The 21 level has been run south about 1000 feet; 15 level south 900 feet; 14 level 500 feet south, and 12 level 850 feet south. In this direction water is increasing and Mr. Crase reports they are now pumping about

300 gallons per minute. The property in general and the surface plant were described in our last county report.

In the Nevada City district the only activity noted in quartz mining is the reopening of the *Constitution* and *Cheyenne* mines.

Sierra County.

Due to snow conditions in the mountains, and the difficulties of traveling, most of the mining news coming out of Sierra County now is hearsay, which can not be substantiated until later in the season, but some of it is interesting.

Alleghany is coming back as a gold producer. The *Sixteen to One Mine* and the *Tightner Mine* are said to be producing a profit from good ore. It has been stated recently that operations at the Tightner have been so satisfactory that the operating company has been able to pay a small dividend after making payment to the owners of a large part of the purchase price of $400,000. A large shaft is being sunk at the Tightner.

Preparations are being rushed with the idea of unwatering the well-known *Plumbago Mine,* which has been the best producer of the Alleghany district in the past but has lain idle for about five years. Griffith and Ray are planning to get supplies to the mine and start a crew at work as soon as possible.

The *Mugwump Mine* has been producing considerable coarse gold, but the average return from a total of 6000 yards of gravel is said to have been only $1.70 a yard, which is a surprise to those who have claimed the gravel would sample $6 a yard.

The *Rainbow Mine* is opened to an additional depth of 300 feet, and drifts are being run both ways on the 300 level. This is new work in addition to the old tunnels that were driven years ago.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Alameda County.

Hoff Magnesite Company: Home office, 333 Monadnock Building, San Francisco; J. M. Hoff, president. Plant at foot of 22d Avenue, Oakland, California., R. Roderick, superintendent. This company manufactures an asbestos magnesite flooring known under the trade name of 'Hoffite,' also stucco, asbestos plaster and a high-heat cement for use inside of furnaces. The company uses calcined magnesite, asbestos, talc, silica and various dry colors in their mixes. Much of the raw material is mined by the company from their own deposits, but some is purchased.

The plant is situated on a Southern Pacific spur track, and the crude materials are unloaded direct from cars to hopper, feeding a jaw-crusher with 8″x 10″ opening, crushing to one-inch size. The crushed material is elevated to a bin by a bucket-belt elevator equipped with magnetic pulley to remove stray iron and steel. From the bin the material passes to a Williams beater mill equipped with air suction system which removes 100-mesh and finer, the oversize going to French burr-stone mills, also equipped with air suction system, which deliver the pulverized product to the packer or finished product bin. When asbestos rock is being used it goes to the Williams beater mill alone to separate the fiber. The fiber is drawn off by air suction and is graded by the pneumatic principle. The barren rock is transferred by worm conveyor to a burr mill and pulverized. For making the various mixes there is a one-ton Broughton dry mixer to which the desired ingredients are fed.

Electric power is used, about 100 h. p. being required, and four men employed. The plant is equipped with a physical testing laboratory and every mix is tested, and the raw materials are analyzed when necessary for control of the product. Practically any color and surface finish is possible. The finished product is shipped in sacks and barrels. A shipment of thirty tons was recently made to China.

Contra Costa County.

Luning Mineral Products Company, L. E. Browne, president and manager; Charles D. Olney, secretary; executive office, 265–268 Russ Building, San Francisco. Plant at 21st and Chanslor Streets, Richmond, California.

This company manufactures water-ground and water-floated pigments and is the only wet-grinding plant of the kind west of St. Louis, Mo. Operations began in an experimental way one and one-half years ago. The company now has a complete plant covering 50 x 210 feet, equipped with machinery which makes the handling of the material from the crude state to the finished product practically automatic. Raw material comes mainly from the mine of the Luning Consolidated Silver Mining Company in Nevada, but this is blended with other ores from various California deposits.

The ore from the Nevada property carries gold and silver values. A cyanide system is incorporated in the flow-sheet of the plant, and the precious metals are recovered, after which a high-grade metallic pigment is made from this tailing.

A third unit has just been completed and this is in an experimental stage, but indications are that several new colors and products will soon be added to the present output. Besides the regular wet-grinding and conveying machinery, the plant is equipped with stationary and rotary kilns, acid tanks, vacuum filters, drying furnaces, air separating system, etc.

Electric power is used throughout. The plant is operating twenty-four hours per day, the product finding a ready market locally among the large consumers.

Mariposa County.

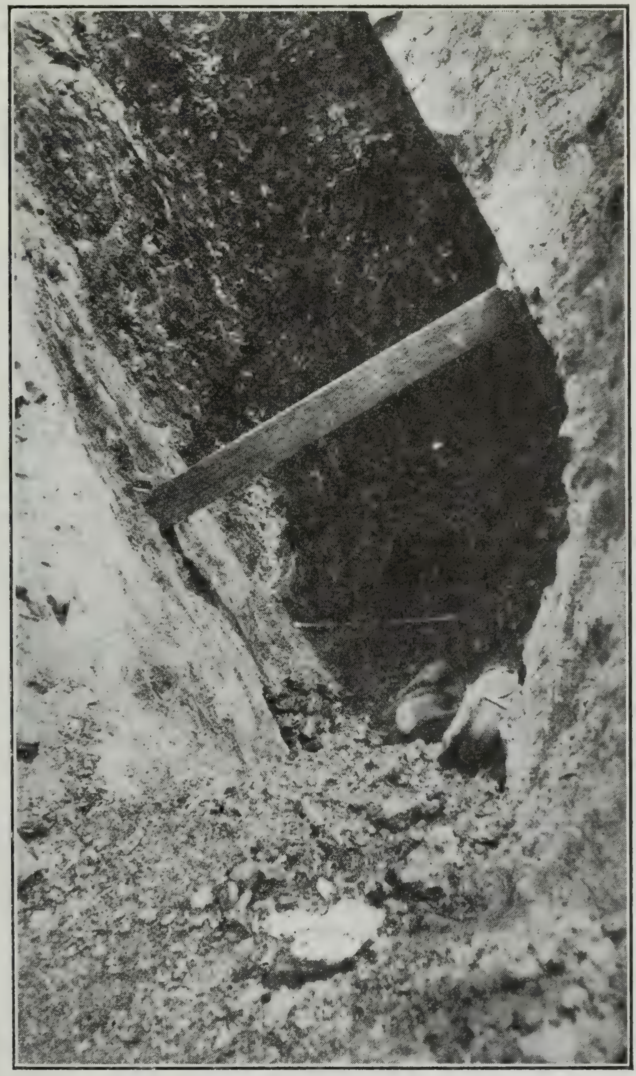
White Oak Mine: John P. Carrol, owner, 2206 E. 16th Street, Oakland, California. Property is about three miles from Bagby and one-half mile from Merced River. Consists of three claims developed by shaft 140 feet deep with north and south drifts at the 110-foot level. According to the owner, the vein is three to four feet wide on contact of diorite and porphyry. A short drift from the 70-foot level in the shaft revealed ore carrying good values in gold. Thirty tons from bottom of shaft milled $21. Average values said to run from $6 to $10 per ton. Three top sets in the shaft are caved, although otherwise everything is in shape to start operations. All necessary machinery is set up, including hoist, compressor and power line. Boarding houses and other buildings are in order, and equipment for a 5-stamp mill is on the ground.

Property is idle at present.

San Benito County.

San Benito Coal Mining Company: Home office, Bank of Italy Building, Oakland, California; John J. Shoo, president, 542 Lakeshore Boulevard; Earl D. White, secretary and treasurer, Bank of Italy Building, Oakland.

This company has recently started development of its coal deposit in San Benito County. The deposit was discovered about fifteen years



Coal vein exposed on property of San Benito Coal Mining Company, San Benito County.

ago and some coal was mined and sold to the New Idria Quicksilver Mining Co., since which time it has been idle and the workings flooded. It was taken over by the present company in August, 1921. The holdings are near the Ashurst ranch on Larious Creek, in the New Idria district. Mendota, the nearest railroad point, is thirty-three miles distant. Llanada is the mine post office.

The coal so far exposed is sub-bituminous in character and occurs in veins from 2½ to 6 feet in width between sandstone walls. Three veins are known and have been traced for several miles on the surface. A tunnel two hundred feet in length cuts a vein five feet to six feet wide at a depth of seventy feet from the surface, and another tunnel six hundred to seven hundred feet in length, one mile distant, has cut the first vein. The veins dip at an angle of sixty to seventy degrees. The property comprises two hundred eighty acres of patented land and other holdings. The mine is equipped with gas engine and blower, track, cars and hand tools. Three men are employed. It is intended to double this force at once and also to put a diamond drill on the property in the near future.

Reported analysis:

	Per cent
Moisture	8.6
Volatiles (including Sulphur 2.58%)	49.5
Fixed Carbon	36.6
Ash	5.3
B. T. U. 10750.	

A sample from a shallow depth, analyzed by Smith Emery & Co., August 16, 1921, gave:

	As rec'd, per cent	Dry, per cent
Moisture	9.45	----
Volatile and combustible matter	43.96	48.55
Fixed Carbon	36.39	40.51
Ash	9.90	10.94
Sulphur 2.90%.		
Calories	5514	6089
B. T. U.	9925	10961

San Francisco County.

Bear Barytes Co., Geo. I. Gleason, superintendent, 310 Irwin Street, is operating a custom grinding plant for industrial minerals such as barite, limestone and so forth. Quartz and silica will not be accepted, and ochres and similar material which stain or color the mill will only be handled if in large enough quantities to justify the work of cleaning all the machinery after the contract is finished.

The plant is situated on a spur track of the Southern Pacific Company and has a receiving-bin capacity of eight carloads. It is equipped with a rock crusher and Raymond two-roller mill with air separation. Final product can be made any degree of fineness up to 400-mesh.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Kern County.

Cove Mining District: *The North Sumner Gold Mines* has been granted a permit from the Commissioner of Corporations to sell 400,000 shares of its treasury stock, at $10 a share, the money to be expended in the development of mining claims in the Cove Mining District, about one mile north of Kernville. Kernville is 42 miles north from Caliente, the nearest railroad point, and is to be connected by a highway from Bakersfield, which is 45 miles distant.

The company has 33.48 acres of patented land, besides three mining locations, making a total of 93 acres. In addition, the company has a ten-year bond and lease on the Beauregard Mine and North Extension Sumner Mine, as well as a ten-year lease on the Urbana and Frank mines. These holdings will give it a large area of mineralized ground for development purposes.

The company contemplates cleaning out and retimbering the Beauregard shaft, making available the ore developed in these workings, and to extend the northeast drift on the 200-foot level, to further explore the vein at this depth with the ultimate purpose of crosscutting the main lode in the Northeast Sumner. It also proposes to retimber the shaft to the 300-foot level and extend the drifts on that level to get into condition for ore extraction. All this work will be above the present water level of the mines, as the tunnel of the Sumner has drained all of these workings.

By drifting to the main lode on the 200-foot level of the Beauregard shaft, an equal depth will be attained at the intersection with the main lode, and an additional depth of at least 250 feet will be gained by drifting north on the main lode.

With the opening up of the 200 and 300 foot levels in the Beauregard, the property should be ready for a milling plant commensurate with the amount of ore developed.

The property has all the necessary factors for low cost operations, such as electric power, plenty of water and ore bodies of good, stoping widths.

Percy V. Long and Robert L. Long are, respectively, president and manager of this company.

These mines are described in Report XIV of the State Mineralogist.

Randsburg District: *The Yellow Aster Mining and Milling Company,* the largest gold producer in the southern part of the state, is now selling a large block of its treasury stock, to provide funds for an intensive campaign of development, so that its present hundred-stamp mill may run at full capacity.

During its sixteen years of active operation it had a bullion production in excess of $10,000,000, from which substantial dividends were paid.

The management claims that ore running as low as $2.50 a ton will net a profit of $0.75 to $1 if the mill be run to full capacity.

In the new east drift on the Rand level, which is entirely in virgin ground, the company claims to have cut sulphide ore assaying $7 to $8 a ton. This is a matter of considerable significance, not only that the ore is of such good grade, but also that the sulphide zone has been penetrated.

Mr. Albert Anker is president and Geo. W. Nicholson superintendent of the company.

Radamaker District: *The Silver Bar Mining and Reduction Company* has been formed to develop a group of seven mining claims in the Radamaker Mining District, about fourteen miles north of Randsburg and three miles northwest of Searles Junction of the S. P. Railroad.

The present workings on these claims consist of an incline shaft sunk to a depth of approximately 300 feet, at an angle of 45 degrees, with some 750 feet of drifting on the 50-foot, 100-foot, 150-foot, 200-foot and 300-foot levels. The ore occurs in quartz stringers assaying from $1 to $32 gold per ton.

San Bernardino County.

The AA1 Rock Salt and Chemicals Company controls saline deposits of salt and calcium chloride, situated at Brystol Dry Lake, about five miles south of Saltus Station on the A., T. & S. F. Railroad. These deposits are held under ten placer locations.

The company will soon be ready to market both its salt and calcium chloride.

Barstow Mining and Milling Company will develop its mining claims, 4½ miles northwest of Barstow. These were located by John Kennedy and are near the famous old 'Waterman' Mine, worked years ago by Gov. Waterman of California.

The present workings on the property consist of a 100-foot shaft sunk on the dip of the vein approximately 35 degrees. From the bottom of this a drift 28 feet long has been run, showing five feet of ore, assaying 10 to 12 ounces silver, for its entire length.

The Mountain Lime Company will operate under lease the limestone quarry in Lone Pine Canyon. This is about seven miles from the railroad. The company proposes to commence operations on a basis of fifty tons per day, and later increase this to a hundred tons. Its comparative closeness to Los Angeles should make it a factor of importance in the limestone business.

Mojave Rand Silver Corporation: This company has several claims north of the North Rand Mining Company, six miles north of Johannesburg.

Development consists of a 75-foot vertical shaft. It is claimed that surface assays showed values of $4 to $18 a ton in gold and silver. Also, that at a depth of 50 feet in the shaft, a selected sample assayed $185 in gold and silver.

An interesting feature of this immediate section is that the ratio of gold to silver is much larger here than at the California Rand Silver and immediate vicinity.

Dr. E. E. Sherrard and J. L. Martin, president and superintendent, respectively, of this company.

The Randsburg Silver Mining Company, locally known as the 'Coyote,' has acquired several groups of valuable mining claims near its original locations. These comprise the Sanderson Group No. 1, consisting of the following claims:

Gap No. 1, Gap No. 2, Trail, Velvet Joe, Dixie Queen, Silver Sceptre, Ryolite No. 3.

Sanderson Group No. 2, as follows: Lookout View No. 1, Top Notch, Velvet, New, Spider and Spider Fraction.

Foster Group as follows: Ryolite No. 1, Ryolite No. 2, Randsburg No. 2, Kelly No. 1 and Kelly No. 2.

Flynn Group as follows: Silver Reef No. 1 and Silver Reef No. 2. With these increased holdings this company materially strengthens its position in this district, and next to the California Rand Silver, Inc., will become the most important factor in the development of the camp.

On Silver Reef No. 1 and Silver Reef No. 2, two diamond drill holes were put down several hundred feet and it is claimed that the cores showed values at a depth of several hundred feet below the surface.

On the Foster Group, the Foster shaft was sunk 265 feet deep and it is reported cut stringers of ore-bearing material.

To develop its group with least possible delay, the company has decided to cut the Foster Group into 17 parcels, 200 feet x 300 feet, and these will be turned over to leasers on a royalty basis. In order to avoid the trouble that resulted in the Grady Lease of the California Rand Silver, Inc., from allowing the Grady Lease to exercise the extralateral rights on all veins apexing within its boundaries, the leases on the Foster Group will be limited in exploration to vertical planes through the boundaries.

Mr. John W. Kelly is president and John C. Wray secretary of the Randsburg Silver Mining Company.

San Diego County.

The Descanso Mining Syndicate has taken over what is known as the Dr. McDougall Mine, one-half mile west of Descanso. This property consists of fourteen claims and development work consists of a tunnel and a 220-foot shaft. This shaft will be unwatered; a vigorous plan of development work has been decided on. It is stated that good values in gold and silver were found in the shaft prior to the suspension of operations.

Capt. J. A. Tregelles is superintendent.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

From March 4, 1922, to and including April 8, 1922, the following new wells were reported as ready to drill:

Company	Section	Twshp.	Range	Well	Field
FRESNO COUNTY:					
Paragon Oil Company	17	19	15	14-P	Coalinga
Union Oil Company	9	16	13	2	------------------
IMPERIAL COUNTY:					
104 Oil and Drilling Company	11	14	16	3	------------------
KERN COUNTY:					
Totem Oil Company	19	25	19	1	Devils Den
Pacific Oil Company	35	30	24	13	Elk Hills
Pacific Oil Company	35	30	24	11	Elk Hills
Pacific Oil Company	35	30	24	15	Elk Hills
Pan American Petroleum	1	31	24	7-E	Elk Hills
Pan American Petroleum	2	31	24	1-F	Elk Hills
Pan American Petroleum	1	31	24	10-E	Elk Hills
Pan American Petroleum	2	31	24	4-F	Elk Hills
Pan American Petroleum	2	31	24	2-F	Elk Hills
Pan American Petroleum	2	31	24	10-F	Elk Hills
Pan American Petroleum	2	31	24	5-F	Elk Hills
Union Oil Company	26	30	24	7	Elk Hills
Coalinga-Kern Oil Co.	21	28	28	6	Kern River
Gray Heirs	3	28	28	39	Kern River
Gray Heirs	3	29	28	39	Kern River
Hibbard Petroleum Company	25	28	27	4	Kern River
Huntington and Northern Pet. Co.	2	29	28	7	Kern River
Union Oil Company	11	28	27	4	Kern River
Universal Oil Company	32	26	21	43	Lost Hills
Boston Pacific Oil Company	32	31	24	6-B	Midway
C. C. M. O. Company	22	31	22	22	Midway
Edwards Petroleum Company	31	32	24	1	Midway
General Petroleum Corp.	32	31	24	5	Midway
Honolulu Consolidated Oil Co.	6	32	24	19	Midway
Honolulu Consolidated Oil Co.	6	32	24	49	Midway
Midland Oilfields Company	24	31	23	1	Midway
Midway-McKittrick Oil Company	4	31	22	1	Midway
Murvale Oil Company	12	32	23	M-12	Midway
Pacific Oil Company	31	31	24	19	Midway
Pacific Oil Company	31	31	24	15	Midway
Pacific Oil Company	31	31	24	13	Midway
Pacific Oil Company	15	32	24	15	Midway
Pacific Oil Company	5	32	24	40	Midway
Pacific Oil Company	5	32	24	38	Midway
Pacific Oil Company	1	32	23	31	Midway
Pacific Oil Company	1	32	23	26	Midway
Pacfiic Oil Company	1	32	23	22	Midway
Pacific Oil Company	31	31	24	22	Midway
Surprise Oil Company	36	32	23	2	Midway
Union Oil Company	34	31	23	11	Midway
Union Oil Company	23	31	22	1	Midway
B. B. and O. Oil Company	28	12	24	24	Sunset
C. J. Berry	34	12	24	10	Sunset
La Plata Oil Company	20	11	23	1	Sunset
Midway Northern Oil Company	32	12	23	9	Sunset
Obispo Oil Company	32	12	23	8	Sunset
The Fremont Oil Syndicate	22	31	38	1	------------------
KINGS COUNTY:					
California Natural Gas and Dev. Co.	12	23	22	4	------------------
Sagebrush Gas and Oil Company	18	22	19	1	------------------
LOS ANGELES COUNTY:					
General Petroleum Corp.	19	4	12	1	Long Beach
General Petroleum Corp.	19	4	12	Black & Signal 1	Long Beach
General Petroleum Corp.	19	4	12	Scoco 1	Long Beach
Henderson Petroleum Syndicate	29	4	12	1	Long Beach
Pelham & McKinnie	29	4	12	2	Long Beach
San Martinez Oil Company	29	4	12	1	Long Beach
Shell Company	29	4	12	1	Long Beach
Shell Company	19	4	12	1	Long Beach
Shell Company	29	4	12	2	Long Beach
Union Oil Company	30	4	12	1	Long Beach

Company	Section	Twshp.	Range	Well	Field
United Oil Company	29	4	12	3	Long Beach
Western Star Oil Company	29	4	12	Griswold 1	Long Beach
Western Star Oil Company	29	4	12	Croswell 1	Long Beach
Standard Oil Company	10	4	14	1	Redondo
Amalgamated Oil Company	21	1	14	416	Salt Lake
Amalgamated Oil Company	31	2	11	2	Santa Fe Springs
Amalgamated Oil Company	31	2	11	3	Santa Fe Springs
Bandini Petroleum Company	5	3	11	1	Santa Fe Springs
Bellview Oil Company	6	3	11	1	Santa Fe Springs
General Petroleum Corp.	6	3	11	85	Santa Fe Springs
General Petroleum Corp.	6	3	11	91	Santa Fe Springs
General Petroleum Corp.	5	3	11	5	Santa Fe Springs
General Petroleum Corp.	6	3	11	87	Santa Fe Springs
Machris Bros. No. 1 Syndicate	5	3	11	1	Santa Fe Springs
Machris Bros. No. 1 Syndicate	5	3	11	Babonet 1	Santa Fe Springs
F. A. Parkford	6	3	11	1	Santa Fe Springs
Shell Company	31	2	11	2	Santa Fe Springs
Union Oil Company	6	3	11	6	Santa Fe Springs
Union Oil Company	31	2	11	2	Santa Fe Springs
Universal Oil Company	6	3	11	1	Santa Fe Springs
Ferguson-Francisco Petroleum Co.	31	1	17	1	------------------
O'Donnell & Wilde	24	1	13	1	------------------
Chas. E. Foster	18	4	12	1	------------------
ORANGE COUNTY:					
Amalgamated Oil Company	34	5	11	5	Huntington Beach
Argonaut Oil Company	2	6	11	1	Huntington Beach
Argonaut Oil Company	11	6	11	2	Huntington Beach
Bell of Montebello Oil Company	2	6	11	2	Huntington Beach
Catalina View Oil Company	2	6	11	1	Huntington Beach
Gypsy Oil Syndicate	11	6	11	4	Huntington Beach
Hamilton Well No. 3	11	6	11	3	Huntington Beach
McIntyre Bros.	11	6	11	2	Huntington Beach
M. H. Mosier, Special	35	5	11	1	Huntington Beach
O'Donnell Syndicate	34	5	11	2	Huntington Beach
Pacific Petroleum Company	2	6	11	7	Huntington Beach
Reliance Oil Company	34	5	11	3	Huntington Beach
Rio Bravo Oil Company	35	5	11	4	Huntington Beach
Standard Oil Company	34	5	11	7	Huntington Beach
Standard Oil Company	34	5	11	8	Huntington Beach
Standard Oil Company	11	6	11	6	Huntington Beach
Standard Oil Company	11	6	11	1	Huntington Beach
Union Oil Company	34	5	11	8	Huntington Beach
Union Oil Company	35	5	11	12	Huntington Beach
Union Oil Company	34	5	11	7	Huntington Beach
Walker Western Oil Company	2	6	11	2	Huntington Beach
Western Star Oil Company	35	5	11	1	Huntington Beach
Fairview Oil Company	4	6	10	1	Newport
Amalgamated Oil Company	28	3	9	2-A	Richfield
Amalgamated Oil Company	28	3	9	4	Richfield
Petroleum Midway Company, Ltd.	33	3	9	3	Richfield
Union Oil Company	33	3	9	5	Richfield
RIVERSIDE COUNTY:					
Beaumont Midway Oil Company	16	2	2	1	------------------
SANTA BARBARA COUNTY:					
Rice Ranch Oil Company	19	9	33	15	Santa Maria
Carpinteria Oil and Gas Company	R.	W. Hill	Tract	1	------------------
VENTURA COUNTY:					
Camarillo Refining and Pet. Co.	27	2	20	2	Conejo
Cooper Petroleum Company	33	2	20	41	Conejo
Cooper Petroleum Company	33	2	20	42	Conejo
Logsdon and Sloan Syndicate, No. 1	4	1	20	1	Conejo
Logsdon and Sloan Syndicate No. 1	4	1	20	2	Conejo
Logsdon and Sloan Syndicate, No. 1	4	1	20	3	Conejo
Logsdon and Sloan Syndicate, No. 1	4	1	20	4	Conejo
Logsdon and Sloan Syndicate, No. 1	4	1	20	5	Conejo
Logsdon and Sloan Syndicate, No. 1	4	1	20	6	Conejo
Mabel King Fallis	33	2	20	1	Conejo
Klatawa Oil Company	12	4	19	12	Piru
Santa Fe Petroleum Company	17	4	18	5	Piru
Oak Ridge Oil Company	18	3	20	12	South Mountain
Globe Petroleum Corp.	34	4	23	7	Ventura
Shell Company	28	3	23	4	------------------

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

BIBLIOGRAPHY OF COAL IN CALIFORNIA.

By E. S. Boalich.

The records of the State Mining Bureau show that coal exists in forty-three counties of California. Many deposits with extensive surface showings have never had a pick driven into them. From their first discovery small commercial importance was attached to a majority of these deposits because the coal is usually low grade, of lignite or subbituminous variety, and better fuel has been readily available. The exploitation or development of a lignite bed in California offered no particular inducement to capital in the past, and discoveries of new coal deposits in localities where transportation facilities were not of the best have aroused little interest.

Petroleum has been so cheap and abundant here that the habit of thinking that all fuel needs would be taken care of automatically has become general.

Within the past few months, however, these ideas have received considerable revision. Without quoting statistics, it is a fact easily proved that consumption of oil is outstripping production. The average price of crude petroleum from the San Joaquin Valley fields in July, 1914, was 40¢ per bbl. for 21° Baumé; in July, 1920, 21 gravity oil was selling for $1.70, and 31 gravity was worth $2.55, with an increase in price for higher grades.

So vitally important is oil for many purposes, that the ordinary consumer not only faces continually increasing prices but it is not beyond the range of possibilities that many demands for oil, or its derivatives, may some day be refused regardless of the price offered. That day is surely approaching, and scientific as well as commercial organizations are beginning to look about for means of relieving the situation.

One means of relief will assuredly be the utilization of low-grade coals and lignites, which are widely distributed throughout the United States.

Experiments which give great promise of success are being made to purify lignites and cheap coals of similar character by some process such as the Trent method, which consists of agitating together powdered coal, water and oil. This produces a partly de-ashed plastic fuel called amalgam, the oil selecting the coal particles and largely excluding the water and ash.

In one experiment on a California lignite, carried on by the United States Bureau of Mines at Washington, D. C., the ash reduction amounted to 26.8 per cent, the combustible recovery was 95 per cent and the sulphur reduction was 12 per cent after treatment.

Other investigative work has been undertaken with the idea of showing how these coals may be utilized in powdered form, either alone or with oil in collodial fuels; to make them into briquets, without the use of an expensive 'binder'; to manufacture gas from them; to obtain for commercial use their other constituents, including ammonia, benzol, toluol, solvents, drugs, oils, and coal tar products too numerous to mention. It has even been shown that an internal combustion engine can be operated with powdered coal, in the place of distillate or gasoline.

The earliest recorded discovery of coal in this State was in 1847, near the town of San Luis Obispo. Croppings of lignite were known in San Diego County at an early date. Also R. C. Taylor, in a book called 'Statistics of Coal,' published in 1885, but written before 1851, mentions the occurrence of coal on the sea coast twelve miles north of San Diego.

The date of the original discovery of coal in Alameda County is not known, but Goodyear, writing in Vol. 2, Geological Survey of California, states that it was some time previous to 1857, as during that year a shaft one hundred feet deep existed at a point near the present town of Tesla, where a coal bed forty inches thick was exposed.

Coal production was a factor in the mineral industry of California from about 1860 to the early years of the present century, when competition with crude oil almost forced it off the market. As mentioned above, however, it will probably not be long before serious attention will again be given to the coal deposits, both developed and undeveloped.

The amount of coal remaining unmined is of course not absolutely known, but the U. S. Geological Survey has estimated[1] that the total workable area in California is about 500 square miles and the original contents of all fields 1,000,000,000 short tons.

Total coal production to January 1, 1921, has been 5,164,658 tons,[2] equivalent to an exhaustion of approximately 7,000,000 tons, or 0.7 per cent of the original supply.

The principal developed coal mines have been those north of Mt. Diablo, Contra Costa County; Corral Hollow, which lies on both sides of the divide between the Livermore Valley and the San Joaquin Valley, mostly in Alameda County; Ione field in the Sierra Nevada foothills, Amador County; Stone Canyon, Monterey County; and near Elsinore, at the eastern base of the Sierra de Santa Ana, Riverside County.

Coal seams have been discovered and prospected to some extent in Butte, Del Norte, Orange, Fresno, Siskiyou, Humboldt, San Benito, Mendocino, Shasta, Trinity, Sonoma, Placer, San Luis Obispo, and twenty-five other counties.

---

[1] U. S. G. S. Bull. 394, 'Papers on the Conservation of Mineral Resources,' 1909, p. 18.
[2] Cal. State Min. Bur. Bull. 90, 'California Mineral Production for 1920.'

Many of these deposits may some day be valuable as a source of local supply, even though economic conditions and quality of the product prevent a large output being placed on the general market.

The Stone Canyon coal has been classed as a bituminous variety,[1] but as far as known most of the others are lignite, being soft and friable, with relatively poor burning and heating qualities.

All known coal deposits in the State are of the Tertiary age,[2] those of Alameda and Contra Costa being earlier Tertiary, or Eocene (Tejon). The others are believed to be later Tertiary, or Miocene.

The areas of coal-bearing rocks were in most instances folded, faulted and eroded after the coal was deposited, so that a careful investigation of geologic relations is more necessary here than in states where the coal measures are more regular and of wider extent.

A great deal of data on the coal deposits of California are in existence, but they are so widely scattered through many publications that they have been of little value to the casual investigator.

As a means of offering an entering wedge to those who may be interested in looking into the coal resources of this State, the following bibliography is presented. Most of the publications mentioned will be found available for reference in the library of the State Mining Bureau, Ferry Building, San Francisco; in the Bureau's branch offices at Redding, Auburn and Pacific Finance Building, Los Angeles; and in the libraries of the various government departments such as the U. S. Geological Survey, as well as in the industrial division of many public libraries and educational institutions throughout the United States.

KEY TO ABBREVIATIONS USED IN BIBLIOGRAPHY.

St. Min. Rept.	California State Mining Bureau, State Mineralogist's Report.
Mines & Min. Res.	California State Mining Bureau, Mines and Mineral Resources, various counties.
Bull.	California State Mining Bureau Bulletin.
Pre. Rept.	California State Mining Bureau Preliminary Report.
Geol. Sur. Cal.	Geological Survey of California.
U. S. G. S. Ann. Rept.	United States Geological Survey Annual Report.
U. S. G. S. Bull.	United States Geological Survey Bulletin.
Geol. Atlas	United States Geological Survey Geological Atlas.
Min. Res.	United States Geological Survey Mineral Resources of United States.
W. S. P.	United States Geological Survey Water Supply Paper.
U. S. B. M. Bull.	United States Bureau of Mines Bulletin.
R. W. Raymond	Mineral Resources West of the Rocky Mountains, by R. W. Raymond and Ross Brown.
U. C. Bull. Dept. Geol.	University of California Bulletin of Department of Geology.
E. & M. J.	Engineering and Mining Journal.
M. & S. P.	Mining and Scientific Press.
Mines & Min.	Mines and Mining.
Jour. of Elec.	Journal of Electricity.

General Articles on Coal in California.

Geol. Sur. of Cal., Vol. II, page 41.
St. Min. Rept. VII, pp. 117, 151; XII, p. 38. Pre. Rept. No. 8, pp. 7, 9.
Bull. 87, p. 32; Bull. 90, p. 19.
U. S. G. S. Ann. Rept. XXII, Pt. III, p. 499; U. S. G. S. Bull. 394, p. 18; Min. Res. 1913, Pt. II, p. 818.
U. S. B. M. Bull. 115, p. 135.
Trans. Commonwealth Club, S. F., June, 1912. M. & S. P. Dec. 8, 1900.
E. & M. J. July 4, 1896. Jour. of Elec. Nov. 1902. Mining World, Feb. 17, 1906.

---

[1] U. S. G. S. Bull. 316, M. R. Campbell, p. 435.
[2] U. S. G. S. Rept. xxii, Pt. 3, p. 499.

Analyses of California Coals.

St. Min. Rept. IV, p. 14; VII, p. 178; VIII, p. 29; X, p. 94; XI, p. 228; XII, pp. 64–5; XV, p. 598.
U. S. G. S. Bull. 471-k; Bull. 581; Min. Res. 1892, p. 310; Ann. Rept. XXII, Pt. III, p. 499.
U. S. B. M. Bull, 22, p. 53.
Geol. Sur. Cal. Vol. II, p. 48.

Briquetting.

Min. Res. 1903, p. 442; 1904, p. 458; 1905, p. 554; 1906, p. 653; 1907, p. 100; U. S. G. S. Bull. 316, p. 460.

Manufacture of Producer Gas.

Min. Res. 1905, p. 556; U. S. G. S. Bull. 316, p. 439.
U. S. B. M. Bull. 13.

Coal Resources of California Counties.

Alameda.
St. Min. Rept. IV, p. 269; VII, pp. 146, 173; VIII, pp. 26, 29; IX, p. 323; X, p. 91; XII, p. 39; XIII, p. 51; XVII, p. 21.
U. S. G. S. Bull. 585, p. 28; Bull. 603, p. 209.
U. S. B. M. Bull. 22, pp. 53, 395.
Geol. Sur. Cal. Vol. II, p. 35.
E. & M. J. Feb. 4, 1889, p. 145.
Mines & Min., Nov. 1898.
Jour. of Elec. Vol. 41, No. 12, p. 559.

Amador.
St. Min. Rept. IV, p. 268; VI, p. 116; VII, p. 150; VIII, pp. 109, 113; IX, p. 323; XI, pp. 146, 148; VII, pp. 40, 65; XIII, p. 51; XIV, p. 11; XVII, p. 413.
U. S. G. S. Bull. 585, p. 28; Min. Res. 1883, p. 22; Geol. Atlas, Jackson Folio, No. 11.
R. W. Raymond, 1874, p. 43.

Butte.
St. Min. Rept. VI, p. 116; VIII, p. 116; XI, p. 166.

Calaveras.
St. Min. Rept. VI, p. 116; XII, pp. 42, 65.

Colusa.
St. Min. Rept. VII, p. 190; VIII, p. 158; IX, p. 188; XIV, p. 178.

Contra Costa.
St. Min. Rept. IV, pp. 14, 267; VI, p. 116; VII, pp. 118, 164; VIII, p. 160; IX, p. 323; X, p. 165; XI, p. 191; XII, pp. 43, 64; XIII, p. 51; XVII, p. 53.
U. S. G. S. Bull. 285-f; Min. Res. 1883, p. 20.
U. S. B. M. Bull. 22, pp. 53, 395.
Geol. Sur. Cal. Vol. II, p. 3–34.
R. W. Raymond, 1874, pp. 39, 42.

Del Norte.
St. Min. Rept. XI, p. 198; XII, p. 50; XIII, p. 52; XIV, pp. 373, 380.

Fresno.
St. Min. Rept. IV, p. 270; V, p. 104; VI, p. 116; VII, pp. 148, 172; IX, p. 323; XI, p. 218; XII, p. 50; XIII, p. 53; XIV, pp. 432–6; XVII, p. 69.
Min. Res. 1885, p. 18; 1892, p. 309.

Humboldt.
St. Min. Rept. VI, p. 117; VII, p. 186; X, p. 207; XI, pp. 227–9; XII, p. 54; XIII, p. 53; XIV, p. 399.
Min. Res. 1891, p. 214.

Kern.
St. Min. Rept. IV, p. 14; V, p. 104; VI, p. 117; XII, p. 457; XIV, p. 479.
Min. Res. 1892, p. 310; 1900, p. 366; 1901, p. 364.

Lake.
St. Min. Rept. XIV, p. 205.

Lassen.
St. Min. Rept. IV, p. 14; V, p. 105; VI, p. 117.

Los Angeles.
St. Min. Rept. IV, pp. 14, 269; V. p. 104; VI, p. 117; VII, p. 148; IX, pp. 204, 208; XIII, p. 54; XV, p. 499.
Min. Res. 1891, p. 214.

Marin.
St. Min. Rept. XI, p. 251; XIV, p. 248.
Min. Res. 1891, p. 214.

Mendocino.
St. Min. Rept. IV, pp. 14, 270; V, p. 105; VI, p. 117; VII, pp. 149, 189; X, pp. 314, 317; XI, p. 255; XII, p. 56; XIII, p. 54; XIV, pp. 415, 418; XVII, p. 144.
Min. Res. 1887, p. 210. R. W. Raymond, 1875, pp. 190, 192.

Merced.
St. Min. Rept. X, p. 331; XII, p. 58; XVII, p. 149.

Modoc.
St. Min. Rept. X, p. 333; XV, p. 241.

Mono.
St. Min. Rept. IV, p. 269; VI, p. 117.

Monterey.
St. Min. Rept. VI, p. 117; VII, pp. 172, 178; VIII, p. 403; X, p. 347; XI, p. 259; XII, p. 59; XIII, p. 54; XV, p. 597; XVII, p. 156.
U. S. G. S. Bull. 285, p. 223; 316-f; 431, p. 243; 581-d, p. 158; 585, p. 29. Min. Res. 1909, p. 102.
U. S. B. M. Bull. 22, pp. 53, 396; 38, p. 37.
U. C. Bull. Dept. Geol. Vol. 1, p. 22.

Napa.
St. Min. Rept. XIV, p. 269.

Orange.
St. Min. Rept. X, pp. 403–405; XI, pp. 114, 116; XII, p. 60; XV, p. 519.
U. S. G. S. Bull. 585, p. 28.

Placer.
St. Min. Rept. IV, p. 268; V, p. 105; VI, p. 117; VII, p. 151; IX, p. 328; XI, p. 321; XV, p. 326; XVII, p. 441; Geol. Atlas, Sacramento Folio.

Plumas.
St. Min. Rept. V, p. 104. Mines & Min. Res. Plumas Co., pp. 18, 32.

Riverside.
St. Min. Rept. IV, p. 14 (under San Bernardino), p. 269 (under San Diego); VI, p. 117 (under San Diego); VII, p. 174; VIII, p. 505 (under San Bernardino); IX, pp. 152, 323; XI, pp. 108, 110, 113; XII, pp. 60, 65; XIII, p. 54; XV, p. 574; XVII, p. 325.
U. S. G. S. Bull. 585, p. 28; W. S. P. 429, pp. 15, 79.

Sacramento.
St. Min. Rept. XI, p. 335.

San Benito.
St. Min. Rept. IV, p. 14; V, p. 104; VI, p. 117; VIII, p. 483; XI, p. 372; XII, p. 61; XIII, p. 54; XV, p. 630; XVIII, No. 1, p. 9.
U. S. G. S. Bull. 431-b; 585, p. 29; 603, p. 209.
U. S. B. M. Bull. 22, pp. 53, 396.

San Bernardino.
St. Min. Rept. IV, p. 14; V, p. 104.

San Diego.
St. Min. Rept. VI, p. 117; XI, p. 96; XIV, p. 713.
M. & S. P. Vol. 16, p. 81. Min. Res. 1885, p. 18.

San Francisco.
St. Min. Rept. IV, p. 14; VI, p. 117.

San Joaquin.
St. Min. Rept. X, p. 564.

San Luis Obispo.
St. Min. Rept. VI, p. 118; VIII, p. 532; XII, p. 61.

San Mateo.
St. Min. Rept. X, p. 588.

Santa Barbara.
St. Min. Rept. VIII, p. 538.

Santa Clara.
St. Min. Rept. IV, p. 14; V, p. 105; VI, p. 118; IX, p. 55; X, p. 609. Min. Res. 1892, p. 310.

Santa Cruz.
St. Min. Rept. VI, p. 118; VIII, p. 553; XVII, p. 235.

Shasta.
St. Min. Rept. IV, p. 270; VI, p. 118; VII, pp. 149, 190; VIII, p. 562; XI, pp. 25, 26, 28, 53, 396; XII, p. 61; XIII, p. 55; XI, p. 756; XVII, p. 515.
Min. Res. 1887, p. 210; 1891, p. 214.
Geol. Atlas, Redding Folio.

Siskiyou.
St. Min. Rept. VI p. 118; VIII, p. 583; XI, p. 449; XII, p. 61; XIII, p. 55; XIV, pp. 811, 817.

Solano.
St. Min. Rept. IV, p. 270; VI, p. 118; VII, p. 151; X, p. 661; XIV, p. 307. Min. Res. 1892, p. 310.

Sonoma.
St. Min. Rept. IV, p. 270; VI, p. 118; VII, pp. 151, 190; VIII, p. 634; X, p. 676; XI, p. 459; XII, p. 61; XIII, p. 55; XIV, p. 319.
M. & S. P. Dec. 28, 1872.

Stanislaus.
St. Min. Rept. X, p. 681; XVII, p. 253; Min. Res. 1892, p. 310.

Sutter.
St. Min. Rept. VIII, p. 637; XI, p. 471; XIII, p. 56; XIV, p. 256; XVII, p. 256.

Tehama.
St. Min. Rept. VII, p. 189; XI, p. 476.

Trinity.
St. Min. Rept. VII, p. 189; VIII, p. 643; X, p. 716; XII, p. 62; XIII, p. 57; XIV, p. 877.
U. S. G. S. Bull. 585, p. 28. Min. Res. 1892, p. 310.

Yolo.
St. Min. Rept. X, p. 790; XIV, p. 367.

THE METALLURGY OF PLATINUM.

Translation by ALLEN C. REDDING,[1] D. Sc., and GEO. M. NELSON,[2] C. E., from 'Le Platine du Monde,' by Louis Duparc.

INTRODUCTION.

By FRANK SANBORN, Petrologist.

Information concerning the metallurgy and mining of the platinum metals is very frequently sought at the laboratory of the State Mining Bureau.

Most of the literature published in English has been on the estimation of platinum in an ore; but the methods usually considered best also have some disadvantages. Crude platinum does not readily go into solution, and when once in is not easily precipitated completely. The several manipulations necessary, the difficulty in handling very small amounts of the separated platinum metals, and the loss of osmium, ruthenium and iridium during cupellation—the latter by spreading over the cupel—all tend to give erratic results in the estimation of platinum.

It is possible that the rather obsolete method of estimating small amounts of platinum by 'difference' could be improved upon and used to advantage in cases where small amounts of platinum are known to exist. Silver and gold are rather easily removed from a platinum solution. Platinum metals can be precipitated with zinc from a very dilute hydrochloric acid solution. Evaporation could be resorted to instead of filtering, and a known amount of gold added to the residue to hold the platinum during fusion and cupellation. The loss of osmium, iridium and ruthenium could probably be lessened by using the method of combining the lead buttons (if more than one fusion is made), scorifying and treating the greatly reduced amount of lead with dilute nitric acid (1 to 8), and treating the residue with dilute aqua regia to obtain insolubles consisting largely of osmium and iridium.

In separating the platinum from sand concentrates there is often left a certain amount of platinum which is probably associated with chromite. One such sample from Beegum Creek, Tehama County, California, contained about four ounces of platinum per ton, but no platinum could be seen in panning the sample. A large part of this platinum was saved by grinding very fine and concentrating carefully.

The data following herewith is a translation of Chapter XV in 'Le Platine du Monde,' by Louis Duparc, Geneva, 1920. This translation has been made especially for this bulletin through the courtesy and cooperation of Dr. Allen C. Redding and Mr. George M. Nelson.

As the literature published in English on the subject of the metallurgy of platinum is rather limited, we have deemed it advisable to reproduce this chapter practically in its entirety, as it is the most recent and one of the most detailed in any language.

Chapter XV, 'LE PLATINE DU MONDE,' par LOUIS DUPARC.

SECTION 1. GENERAL CONSIDERATIONS ON THE SUCCESSIVE OPERATIONS USED IN THE METALLURGY OF PLATINUM.

The mineral as it comes from the mines is a complex alloy of the precious metals with iron and often with copper and nickel. The separation and purification of these different metals is a long and difficult operation which requires a certain amount of practice.

---

[1] Consulting Mining and Metallurgical Engineer, San Franisco.

[2] Civil and Mining Engineer, San Francisco.

The methods which are actually in use in most platinum refineries were partly devised by Wollaston, Klaus, Saint-Claire Deville, Debray and Staas. Their descriptions are scattered throughout the different publications of these authors, and their study is necessary for everyone who desires to undertake the refining of platinum.

First, we shall consider only the extraction of platinum. The accessory metals of this group being of only secondary importance, often the residues have not been separated and these have accumulated during many years and constitute a source of unappreciated wealth. After platinum the iridium is the most important, its increasing usefulness requires its extraction from the 'osmiures.' Then comes palladium and rhodium, which find a use, and then osmium and ruthenium, the last with but little use at present.

The metallurgy of platinum is mostly carried on by the wet process. It requires several manipulations, which are:

First.—The dissolution of the mineral in aqua regia with the separation of the insoluble 'osmiures.'

Second.—The precipitation of the platinum in the form of ammonium chloroplatinate, and the transformation of this into platinum 'moss,' which is condensed in a furnace.

Third.—The reduction with iron, or with zinc, of the 'mother liquors' obtained and the precipitation of the platinum as the chloroplatinate, and for the extraction of the metals other than platinum, which are called 'first blacks,' and their treatment.

Fourth.—The treatment of the 'osmiures' for the extraction of iridium and osmium, and other accessory minerals.

Fifth.—The fusion of the metals obtained in these several operations, the preparation of alloys and their uses.

It is not until we recognize the different operations which are necessary in the refining that we can understand the general disposition of serviceable methods of this kind of work.

SECTION 2. DISSOLUTION OF THE MINERAL AND THE SEPARATION OF THE 'OSMIURES.'

The mineral is previously rendered as pure as possible by eliminating the last traces of chromite, with which it occurs, and the separation of the gold which accompanies the platinum. The gold is generally taken up by the use of heated mercury, which dissolves it; then extracted from the amalgam by the volatilization of the mercury in an appropriate apparatus. This separation is generally made at the mine. The mineral is generally sent to the refinery without other preliminary preparation.

The dissolution of the mineral is made by aqua regia at a temperature of about 80° C. The mixture of acid used is composed of 3 volumes of hydrochloric acid of 20° Bé. and 1 volume of nitric acid at 35° Bé. For 1 kg. of mineral 4 litres of the mixture of acids is generally used.

The apparatus used for this work varies in the different refineries. Certain refineries take simply the mineral, put it in a glass flask with a narrow neck that will hold 6 or 8 litres and heat it on a sand bath or an air bath, or over an open fire, like a gas stove, according to Wiesnegg's system.

This method of operation is not to be recommended because of the fragile nature of the glass flasks, and the small quantity of mineral which can be treated in each container. During the process, and especially at the beginning of the action, there is discharged large volumes of nitrous fumes, which are very obnoxious. The flasks in which the dissolution is made are generally arranged in batteries and under a hood with a good draft.

In certain English and French refineries the dissolution is made in cylindrical porcelain or earthenware jars. They are made to hold about 30 litres, provided with a ground-on cover containing three holes; one to introduce the acid, another the mineral, and the third, the one in the center, for the escape of the vapors evolved during the chemical reaction. This last hole is provided with a short tube which passes through the porcelain cover. A number of these units of apparatus are arranged in a battery in a long sand bath, heated ordinarily with gas and placed under a hood. The discharge tubes run up into the hood, and enter a main earthenware canal through which is produced a strong draft by making connection with the chimney and utilizing the ventilator. The chemical action is easily produced with this apparatus and no annoyance is experienced by the vapors that arise during the action.

In other refineries, notably in Russia, they use porcelain appliances, otherwise little changed. They are cylindrical and are provided with porcelain covers ground on, and provided with four circular openings; the center one for the introduction of a 'stirrer'; the others near the 'perifery' serve for the escape of the vapors, the introduction of a thermometer and of the acid. The apparatus measures 55 cm. in height and 36 cm. in diameter. It is heated on an air bath, the flame of which strikes directly on a plate of asbestos placed about 15 cm. under the bottom of the jars. Between this and the disk is an air bath which is kept at a temperature that can be regulated by the burner cocks.

In the English type of apparatus for treating 3 kg. of mineral at one operation there is required 12 litres of aqua regia. In the Russian type they treat at one time 5 or 6 kg. of mineral. It is customary to complete one lot in 24 hours, then decant the acid liquors and refill with other mineral and allow the 'osmiures' to accumulate.

The first treatment does not render all the platinum soluble. Generally the residue of two or three dissolutions is submitted to repeated weak treatments which yield a small amount of platinum and much iridium.

The solution obtained by the dissolution of the mineral is transferred to a larger hemispherical porcelain vessel holding 8 to 9 litres of liquid.

The liquid is evaporated on an earthenware plate in a good draft. The vessels are placed in series and held in place by a sheet-iron form, or on a truncated cone, with an opening for the escape of the stove gases. The flame is regulated until a tranquil evaporation is secured. The liquid is often stirred with a glass rod. In some refineries this evaporation is made on a sand bath. During the evaporation about a litre of chemically pure hydrochloric acid must be added, one litre for every 6 or 7 litres of the first solution. This operation is to completely remove all of the nitric acid and to transform all the salts into chlorides. Ordinarily the evaporation is pushed on to dryness, or to a pasty consistence. The temperature of the mass at this time must be between 140° and 150° C. This is indispensable in order to reduce the salts of iridium to a minimum. In most refineries they do not measure the temperature and the operator must be the judge when to stop the evaporation. In other refineries they operate at a determined temperature, and the evaporation is conducted on a sand bath or an air bath and pushed to dryness. It is indispensable that all the nitrogen products be thoroughly eliminated and the temperature toward the end not too low, or it would precipitate the iridium with the platinum.

The mass is then redissolved in boiling water, and after it is all dissolved the solution is transferred to a larger porcelain vessel—large enough to receive the solution of several runs. It is left to stand for a few hours, and usually forms a small deposit of gold, if there be any with the mineral, and a little platinum chloride. The clear liquid is siphoned off and the residue filtered and washed. The residue is calcined, redissolved in aqua regia and the solution treated with bisulphite of soda after evaporation of the hydrochloric acid. The gold precipitate is washed, dried and calcined; the filtered liquid added to the mother liquor of platinum.

SECTION 3. PRECIPITATION OF THE PLATINUM AND THE PREPARATION OF THE 'MOSS.'

The siphoned liquid is generally too dense. It is brought to 30° Bé. and to it is added a saturated solution of ammonium chloride, prepared by dissolving crystallized ammonium chloride to make a 30% solution.

The density must be 10° Baumé. About two litres of the ammonia solution is required for each litre of platinum in order to precipitate all the platinum.

This operation is performed in a large cylindrical porcelain jar holding about sixty litres.

The ammonia solution is added in small quantities with energetic stirring, and allowed to stand for 3 or 4 hours to permit the precipitate to settle. It must not stand too long, in order to avoid a partial precipitation of iridium.

The precipitate of chloroplatinate of ammonia must be canary yellow. The clear liquid must be separated from the precipitate by decantation. This decanted liquid is often highly colored.

The precipitate is repeatedly washed with a saturated solution of ammonium chloride. It will require about 30 litres of the ammonia solution to wash the precipitate produced. The precipitate is passed through a filter and washed until the filtrate does not show any color with potassium ferro-cyanide. The method of filtering varies at different works. In some the precipitate is washed entirely by decantation, then transferred to filter presses.

The yellow precipitate, well dried, is introduced into earthenware pots 30 cm. in height and 20 cm. in diameter, provided with a well-fitting cover. It is far better to use crucibles of fused quartz. These crucibles with their contents are moderately calcined in a reverberatory furnace. The flame must be projected on top of the crucibles and must be a reducing flame. The temperature must be between 700° and 800° C. and the heat must be raised gradually. Earthen crucibles are not recommended for this operation, as it is well known that the 1% of iron in the clay used to make these crucibles passes into the platinum.

The time required for this calcination is about 8 hours. After cooling, the 'moss' is crushed in a mortar, screened and put into a vessel with boiling dilute hydrochloric acid—one to five—to remove any trace of iron which it may retain, and washed with boiling water.

The spongy 'moss' thus obtained is often used as it is; for example, if it is to be used in the manufacture of alloys or to be redissolved. If, on the contrary, it is to be made into an agglomerated mass, it must be again charged into a crucible and given a dead calcination in a coke oven with a good draft. The crucibles are covered and placed under the coke. The agglomerated mass is obtained in one block and can be forged directly. If the platinum is to be melted, this block is not well suited. In that case, there is placed in the crucibles some pieces of the spongy 'moss,' separated from each other by disks of filter paper, and the charge calcined as before. Then, instead of one block of platinum, as many little patties are obtained as there were layers.

The purity of the first quality of platinum naturally depends on the purity of the chloroplatinates. In certain cases a purity of 99.8% is obtained, but often the platinum contains as much as 1% of iridium, or more.

Certain processes are proposed for the rapid determination of the purity of this platinum.

In certain refineries, notably in Russia, they mix solutions of the platinates containing an increasing amount of iridium from $\frac{1}{10}$% to 1%. These are standard solutions. The different solutions (standard) are poured into sampling dishes and precipitated with ammonium chloride solution, all under the same conditions, and precipitates obtained with colors varying from canary yellow to orange, in proportion to the amount of iridium present. The platinum solution also is precipitated and by comparing the color of the precipitate with the standard solution precipitate an estimate of the percentage of iridium contained in the original solution is arrived at.

This method is not very accurate, as experience shows that with a solution of pure platinum the color of the precipitate will vary with the conditions under which the precipitation was made.

In other refineries they take a small piece of mossy platinum and test it as follows: It is melted and drawn into one of the elements of a thermo-electric couple with platinum and 10% of rhodium. The purity of the platinum can be estimated by the electromotive force produced at a given temperature. This method is one of very great sensibility. It does not indicate the total of the strange metals contained in the platinum, like iridium, rhodium, palladium, etc. Only iridium can be found in appreciable amounts after the formation of the chloro-iridiate of ammonia. The other metals can not be found except by the absorption phenomena.

The method of measuring the electromotive force is very valuable in testing the platinum to be used in the manufacture of thermo-electric couples, required for the graduation of electric apparatus.

The spectroscopic method offers another method remarkably accurate and rapid for the verification of the purity of platinum. This method gives at once the qualitative and the quantitative composition by comparison of the intensity and number of lines of the different impurities contained in the platinum.

The liquid filtrate of chloroplatinate of ammonia is very clear. It is left standing for several days in a porcelain crucible, when it deposits a reddish crystalline precipitate which is principally chloro-iridiate of ammonia. This is filtered, washed, dried and calcined like the preceding. Thus is obtained what is called 'moss salt,' which contains much iridium and a little platinum. This moss is generally re-treated in a porcelain crucible with aqua regia to which has been added three times its weight of water. The platinum is easily dissolved and the iridium remains insoluble. The solution containing the platinum is precipitated as before in the form of 'moss salt.'

Section 4. Treatment of the 'Blacks.'

The liquid filtrate, after the precipitation of the platinum, is poured into earthenware jars holding about 200 litres, and to it is added 2 or 3 litres of sulphuric acid, so that the solution is slightly acid; then a few bars of soft iron are immersed, or bars of zinc if it is desirable to hasten the reduction. The soft iron bars will answer, but under no condition must steel or cast iron be used. The solution is progressively reduced and acquires a pale green tint due to the presence of ferrous sulphate. That the operation is complete can be judged by acidulating some of the solution and testing with a piece of zinc. If it does not form a black deposit, the reduction is complete. If a black deposit forms, it is examined to see if it contains any of the other precious metals, and in that case the reduction is kept going.

Deposits are formed in the bottom of the jar (and sometimes on the iron bars, which must be removed) of a black and pulverulent mass called 'first blacks.' This black mass is filtered in a vacuum filter, washed with boiling water, and after drying is charged into a cupel made of refractory earth (bone ash) and roasted in a muffle. The product from the cupel is put into a porcelain crucible, cleaned with hot dilute sulphuric acid —1 to 5—which removes all the copper which was in the form of an oxide and associated with the black mass. The liquid is decanted, washed several times with hot water, and platinum black is obtained, which is only the cleaned 'black.' This 'black' is dissolved in the same crucible and heated with aqua regia diluted with three times its weight of water until it ceases to react. We then obtain:

A. An insoluble residue which contains rhodium and iridium, and which is called 'insoluble blacks.'

B. A solution containing a little platinum, which has escaped precipitation by ammonium chloride (the cause being the partial solubility of the chloroplatinate, or the defective preparation of the precipitating solution), then palladium and traces of rhodium and iridium, notwithstanding their insolubility in the aqua regia.

The amount of platinum that may be thus extracted from the mother liquors depends on the way they have been treated. It may be great enough in the event the evaporation to dryness has been carried on at a sufficiently high temperature, which carries a partial reduction of chloroplatinates in the acid chloroplatinates.

This condition is recognized by the fact that the filtrate will reprecipitate new quantities of yellow platinum. The same phenomenon is produced if the nitrates have not been completely recovered. The liquid may sometimes retain as much as 3% of platinum in the form of nitrates. Introduce a piece of zinc and the chloroplatinate is immediately precipitated. In this case the reduction of the mother liquor must be pushed as far as possible to avoid the presence of the yellow platinum precipitate, which would be annoying when washing and drying. The solution 'B' is separated from the 'blacks' 'A' by filtration and washing with boiling water.

SECTION 5. EXTRACTION OF THE PLATINUM AND THE PALLADIUM.

The filtrate solution 'B' is treated the same as previously stated in the dissolution of the minerals, and after the separation of the 'osmiures' ammonia chloride is added and the platinum precipitated as chloroplatinate of ammonium. This is filtered, washed and calcined. The product is called 'black platinum.'

We now have three products which in total weight represent all the platinum contained in the mineral:

First.—The 'moss' of the first precipitation;

Second.—The 'moss' of the platinum 'salts';

Third.—The platinum black.

This weight should represent 100% of the platinum content of the mineral, as shown by analysis, by the method previously indicated. Certain refineries are content with the purity (99.8%) indicated. The platinum first obtained is considered pure enough for the market as it is. Others redissolve the mosses and reprecipitate a second time.

The 'moss' may be purified by treatment with aqua regia, which dissolves the platinum and leaves the iridium insoluble.

The filtered solution is concentrated, then precipitated with ammonium chloride, as before indicated. The subsequent manipulations are the same as have been previously described. The solution filtered from the platinum black contains all the palladium. It is acidulated with sulphuric acid, treated in jars of porcelain with bars of soft iron, as has been indicated previously in reference to the first 'black'; a precipitate called the 'second blacks' is apparent now by the palladium. This has taken down with it traces of rhodium and iridium.

These 'blacks' are cleaned with dilute—1 to 3—solution of hydrochloric acid, which removes the iron. They are then filtered, washed and dried and then dissolved in aqua regia. The clear liquid obtained is decanted, if it contains any sediment due to separated traces of rhodium and iridium, then evaporated in porcelain dishes till it attains a spongy consistency, without heating it too hot. The spongy mass is dissolved in ammonium hydroxide (NH_4OH) in the same vessel in which the evaporation took place. The resultant liquid is colorless and is an ammoniacal solution of palladium chloride. To the clear solution containing the palladium chloride, hydrochloric acid is added to aid reaction. This operation is done in a large earthenware jar. The palladium precipitate is yellow, and is in the form of chloropalladiate. The clear liquid, after the precipitation has subsided, is siphoned off, the residue filtered, washed and the filter and precipitate calcined in a muffle furnace, using a retainer of refractory earth. To render the palladium most pure, the operation is repeated by redissolving and evaporating, and dissolving in ammonia and precipitating with hydrochloric acid. The filtrate from the palladium still contains traces of rhodium and iridium. It is added to the last wash water from the platinum.

SECTION 6. EXTRACTION OF IRIDIUM AND RHODIUM.

The insoluble 'blacks' are mixed with three times their weight of powdered barium dioxide (BaO_2), intimately mixed, put into a crucible and strongly calcined in a coke oven for five or six hours. The 'moss' is taken from the crucible, after cooling, ground to powder and dissolved in acid compound of 15 litres of hydrochloric acid and 2 litres of nitric acid. All should dissolve, but if by chance there remains a residue, the liquid is carefully decanted, the residue washed in hot water, and after drying re-treated with barium dioxide as before.

It requires about 4 litres of the mixed acids for each kilogram of the mixture of 'blacks' and barium dioxide. The solution obtained is feebly colored red. It is evaporated to dryness in a porcelain dish on a sand bath, then silica is added with hot water to which has been added some of the aqua regia of the composition as above, the whole thoroughly washed, allowed to settle, and the clear liquid decanted. The residue is washed with boiling water and transferred to a cloth filter. The residue is allowed to remain in the silica which has been washed with hot water until the filtrate becomes colorless.

The filtered solution is added to the wash water, reconcentrated and the barium precipitated with sulphuric acid. The liquid is filtered and the precipitated barium sulphate thoroughly washed with hot water. The precipitate should be pure white. The liquid, which is free from barium, is poured together with the wash water, previously concentrated, into a porcelain dish, heated on a sand bath and from time to time small amounts of ammonium chloride crystals are added until the solution is saturated. It generally requires in the neighborhood of 300 grams of the salt to each litre of liquid. The temperature is maintained for 3 or 4 hours, and purplish-black precipitate of choloro-iridiate obtained. The last wash water should be feebly colored. The precipitate will contain the iridium and the filtrate the rhodium. The precipitate, after drying, is calcined in a silica crucible in a reverberatory furnace at a temperature a little lower than that used for the platinum. The temperature should be raised very gradually to prevent losses. The product of the calcination is iridium oxide (IrO_2). It is not necessary to clean it. It is introduced into a graphite crucible and given a dead roast; the result is an agglomerated mass.

The solution separated from the iridium is transferred to a vitrified earthenware jar, acidulated with sulphuric acid and reduced with bars of soft iron. The deposit (blacks) that is formed is cleaned with dilute hydrochloric acid—1 to 3—washed and dried. This is crude rhodium.

In some refineries the process as given above is modified as follows:

The 'blacks' are heated for two hours with three times their weight of barium dioxide at a temperature between 700° and 800° C. The 'moss,' which can be easily separated from the crucible, is placed in a crucible, without pulverizing, and treated directly with boiling water. The 'moss' disintegrates instantly and falls to a powder. The excess of barium dioxide which has not reacted is dissolved in the water and easily eliminated by decantation. The residue, after washing, is treated with the mixture of acids previously indicated. Without evaporating precipitate the excess of barium with sulphuric acid, after filtering out the barium sulphate, transfer the filtrate to a porcelain jar, and precipitate the iridium with ammonium chloride. From this point the treatment is as has been indicated above.

This method is much more rapid as well as more economical. It requires only 2 litres of the mixed acid for each kg. of 'blacks.' This method also eliminates the evaporation, and the silica is discharged as barium silicate ($BaSiO_2$) by washing with hot water.

SECTION 7. TREATMENT OF THE 'OSMIURES' OF IRIDIUM.

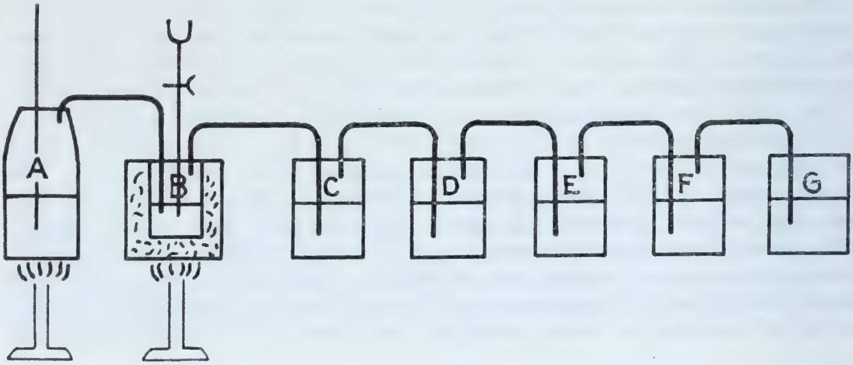
The 'osmiure' must be reduced to as fine a condition as is possible. If this is not done it must be melted with 4 or 5 times its weight of pure zinc. This compound must be heated to a very high temperature in order to volatilize the zinc and effect a decomposition of the 'osmiure.' The temperature must be raised very gradually until it reaches a white heat and this temperature maintained until the zinc vapors cease to be evolved.

For this purpose use a graphite crucible with cover luted on tight; a small hole is drilled in the cover, through which the zinc vapors can escape. When the zinc has been evaporated there is left in the crucible a moss of osmiure sponge which may easily be reduced to a fine powder.

The first part of the treatment is the same as has been indicated in the treatment of 'blacks.' The osmiure is mixed with three times its weight of barium dioxide and introduced into a covered crucible and heated to a red heat for 2 or 3 hours. The crucible is emptied and the moss pulverized. The pulverized moss is washed by any convenient method and introduced into a distilling apparatus. This procedure omits the evaporation to dryness, which saves not only a great deal of expense but is a great saving in time, and distillation is reduced to about one-third. At the same time as great a quantity of osmiures can be treated as by the old method.

The following is a general description of the apparatus employed by Deville, except the furnace and the size of the vessels used. The apparatus permits the distillation of the osmiures with facility and without being discommoded by the disengagement of the osmic vapors, which are always very obnoxious.

The black mass resulting from the washing with hot water, the product of the treatment of the osmiures by barium dioxide (BaO_2), is washed and dried.



Ten kilos are poured into the inner vessel 'B.'

Vessel 'B' is of earthenware, and cover is provided with three openings, and has a capacity of about 40 litres. This vessel is immersed in a large enameled iron basin filled with hot water and heated by means of a gas burner.

Through the first opening pass a glass tube, the end of which is closed and which at about 10 cm. is perforated with little holes. This is to permit the escape of the watery vapor coming from the copper vessel 'A,' which is provided with a safety tube. Through the second opening is poured the material, and also the acids necessary for the reaction. Through the third opening pass a glass tube to permit the passage of the mixed acid vapors of the peroxide of osmium which are condensed in the Woulff bottle 'C.'

This bottle collects the larger part of the condensed vapors, but is again connected with a second bottle, 'D,' the same as 'C,' which likewise connects with a similar bottle, 'E,' half full of water, in which collect the vapors that were not condensed in the previous bottles. This bottle communicates with bottles 'F' and 'G,' which contain caustic soda and sodium sulphate. These two last bottles absorb the entire balance of the vapors of the osmiures which may have escaped condensation in the previous bottles.

The starting of this chain of apparatus is quite simple. Place a gas burner under each of 'A' and 'B.' Pour into 'B' successively 10 kilos of the material to be treated, together with 15 litres of hydrochloric acid and 2 litres of nitric acid. Pass the water vapor from 'A' to 'B' and the reaction commences immediately. The displaced air-bubbles are up in the bottle for a time, but soon all the gases are entirely condensed and absorbed. The water in the first Woulff bottle is rapidly saturated with hydrochloric acid. The solution of hydrochloric acid must be replaced, at each new operation, with pure water.

The operation is completed in 5 or 6 hours. The osmic acid must then be completely removed from the iridic liquor in 'B.'

The apparatus can be again recharged, and in this way treat 20 kilos of osmiure per day, corresponding to 7 or 8 kilos of pure osmium.

The iridate liquor is poured into a porcelain vessel and precipitated hot with crystals of ammonium chloride, as before described in the treatment of the 'blacks.' The temperature is maintained for about 2 hours and too great a concentration must be avoided. The clear liquid is decanted and the precipitate of ammonium chloro-iridate is washed, filtered and washed again, as usual. When dried it is calcined in a refractory crucible in a reverberatory furnace, an impure moss is obtained that is cleaned by aqua regia to which has been added three times its weight of water. The platinum and palladium dissolve and the ruthenium and iridium remain insoluble. The insoluble moss is given a dead roast in a graphite crucible.

The platinum is precipitated from the filtrate as usual.

SECTION 8. TREATMENT OF THE 'OSMIURES.'

The Woulff bottles 'C,' 'D,' 'E' and 'F' of the apparatus used in the distillation of the osmiures contain osmic acid in solution. The contents are poured into a porcelain vessel and ammonium chloride added and the whole heated for one and a half hours to convert the osmic acid into osmianide. It is then filtered and washed with hot water, dried and given a dead roast in a graphite crucible to obtain metallic osmium.

This process is disagreeable on account of the formation of noxious vapors during the transformation and even during the conversion of the osmic acid to the osmianide.

The following method partially obviates this disagreeable feature: The contents of bottles 'C' and 'D' are siphoned over into a jar containing a mixture of sodium hydroxide and sodium sulphate. Then the contents of 'E' and 'F' are added and all the 'osmiures' precipitated. This precipitate is filtered, washed, dried and given a dead roast in a graphite crucible.

The treatment of osmium and its compounds is always a disagreeable operation because the osmuim vapors are very obnoxious. All operations, whether dissolution or distillation, must be done under a hood with a good draft.

Section 9. Separation of Iridium and Ruthenium.

Often these two metals are not separated, and the whole sold under the name of iridium, although it does contain more or less ruthenium. This causes great inconvenience, and notably when the supposedly pure iridium is used to make alloys with platinum. The ruthenium introduces to the alloy properties that are very prejudicial. To effect a separation of the two metals the procedure is as follows:

The moss, consisting of iridium with a little ruthenium, is melted in a silver crucible provided with a cover—a gold one would be preferable—with a mixture of three parts of potassium hydroxide and one part of potassium nitrate. The mixture of potassium hydroxide and the nitrate is brought to a quiet fusion, then the moss added and the cover left so the action can be examined from time to time.

The operation is done in a muffle furnace at a dark red heat. It will require from one and a half to two hours to complete the action. It is often well to stir the fused mass with a silver rod. After cooling, the mass is dissolved in cold water. The ruthenate of potash (K_2RuO_4 H_2O) is dissolved, giving a light-red colored solution due to a trace of iridiate of potash, while the iridium remains insoluble. The clear liquid is decanted and the residue washed with a dilute solution of sodium hypochlorite until it shows no more red coloration. The residue is sometimes not pure iridium but contains small particles of ruthenium. The residue is then dried and cleaned with water acidulated with hydrochloric acid to remove the last traces of potash, and then calcined in a refractory crucible in a muffle furnace. This decomposes the iridiate of potassium into iridium and potassium. The residue that is left after eliminating the potassium is put into a porcelain crucible with hot water and a very dilute solution of hydrochloric acid in order to remove the last trace of potassium. The acid must not be too strong, or the entire mass will pass into solution. The iridium which remains on the filter is washed, dried and given a dead roast in a graphite crucible. The result is an iridium agglomerate.

The solution which contains the ruthenium (with a trace of iridium) is reduced with zinc after acidulating the solution with sulphuric acid. After complete reduction a black powder is obtained. The clear liquid is decanted and the residue washed and dried, and an impure ruthenium 'black' obtained.

SECTION 10. TREATMENT OF THE MOTHER LIQUORS AFTER THE REMOVAL OF THE PLATINUM, IRIDIUM AND RUTHENIUM.

The mother liquors are acidulated with sulphuric acid and reduced with soft iron. The 'blacks' which have been deposited contain the rhodium, a trace of platinum and gold. These blacks are thoroughly washed and slightly calcined, then treated with aqua regia diluted with three times its volume of water. The rhodium remains insoluble (together with traces of iridium, if there be any), and the platinum, palladium and gold pass into solution. This solution is evaporated in a porcelain dish to the consistency of syrup, and the nitric acid expelled. It is then dissolved in water and a current of sulphurous acid gas passed through the solution. The gold is precipitated, filtered, washed and calcined in an annealing cup. To the filtrate is added sulphuric acid and reduced by means of zinc. The result is palladium 'black.' This is cleaned with dilute hydrochloric acid, filtered, washed, dried and calcined (metallic palladium).

SECTION 11. MELTING THE PLATINUM.

In the beginning of the platinum industry the platinum was not melted, but simply agglomerated. The agglomerated mass was calcined until it was white in a refractory crucible, then put into a hydraulic press. The block obtained was heated time and time again and forged by hammering. Platinum melts easily in the flame of an oxyhydrogen blowpipe, and can be cast like other metals. The fusion is always made in quicklime (CaO), which must be as pure as possible and of particular texture. To secure such a mass of quicklime, take a block of pure limestone ($CaCO_3$) of the necessary dimensions, and carefully calcine until it is reduced to quicklime (CaO). The block of quicklime is sawed into two unequal pieces; the larger one is to be used as the furnace and the smaller one for the cover. The blocks thus produced are carefully bound with pure iron wire and fitted into an iron frame made for the purpose. The bottom of the furnace is the crucible. It should be sufficiently thick and the center scooped out to make the crucible. The walls should be at least 3 or 4 centimeters in thickness. The cover is slightly scooped out so as to form an arch, and should tightly fit the furnace. A small hole is provided as an outlet for the flame of the blowpipe to escape. In the center, or near it, a conical hole is made, through which enters the blowpipe. The blowpipe should have a platinum tip about 4 cm. in length. An ordinary oxyhydrogen blowpipe will do; or an acetylene outfit will probably give the sufficiently high temperature required (about 1800° C.).

To start the fusion put on the cover, open the hydrogen cock slightly in order to get a small current of the combustible gas, then open the oxygen cock. After regulating the flow of gases to reach the proper mixture to secure the maximum temperature, introduce the flow into the hole in the cover designed for the flame. Be careful to adjust the blowpipe tubes so as to get the proper flame of gases in order to secure the highest temperature possible, which must be about 1800° C.

The pressure on the oxygen tank should be from 40 to 50 mm. of mercury. The platinum then rapidly melts, forming an incandescent mass at the bottom of the crucible.

It must not be forgotten that melted platinum, like silver, occludes oxygen, and likewise gives it out on cooling, causing 'spitting.' When the fusion is complete allow the temperature to diminish very gradually. The oxygen dissolved (occluded) is burned off. This is accomplished by diminishing the quantity of oxygen and allowing an excess of hydrogen to enter the furnace. This action produces a sort of ebullition in the mass of molten platinum. Should the metal be desired as it occurs in the oven, extinguish the flame of the blowpipe and allow the furnace to cool. However, on the point of solidification small bits of the metal are thrown (spitting) against the cover or sides of the furnace, caused by the escape of the occluded oxygen which was not thoroughly burned off, as indicated above. This action does not cause any inconvenience.

Should it be desired to cast the metal, the cover is removed, together with the burner, and the molten metal quickly poured into the ingot mould, which has been previously heated.

On account of the intensity of the light of the incandescent molten platinum, which sometimes seriously affects the eyes, it is advisable to wear colored glasses (violet).

The fusion of the platinum in caustic lime is the best way to secure the metal in a solid form. The crude platinum before melting always contains a trace of osmium and a varying amount of silicon. The osmium is oxidized to osmic acid (H_2OsO_4) or to osmiamic acid ($H_2N_2Os_2O_5$) and is thrown off, while the silicon forms a silicate of lime ($CaSiO_3$) and forms a globular mass analogous to a borax head, which is rapidly absorbed by the walls or cover of the crucible. The platinum is then in the form of a metal as soft as copper and with a density of 21.15.

The apparatus above described is sufficient to fuse, at one time, from 2 to 3 kg. of platinum.

When it is desired to make a larger fusion (15 or 20 kg.) and to cast the metal, it will require a somewhat different and, of course, larger furnace, which may be easily tipped, to effect the casting of the metal. To hold the furnace with a pair of tongs is a risky operation. The larger furnace may be made as follows:

Make a cylinder of heavy sheet iron of any computed size, with one end closed. By means of lugs and bolts the cylinder is attached to a swinging frame of iron whereby the cylinder may be partly or wholly inverted. Into this cylindrical form of sheet iron is carefully placed pieces of quicklime so as to make a complete lining around the sides and over the bottom. The sides of the lining should extend about 2 cm. above the sheet iron frame. The pieces on the side from which it is intended to pour the melted metal, should extend about 3 cm. above the metal form, and in this should be constructed a pouring spout. This must be of sufficient size and so constructed that when pouring the melted platinum none of it should come in contact with the sheet iron frame; or fill the entire cylinder with pieces of quicklime, carefully adjusted and firmly packed in, allowing it to project 2 or 3 cm. above the frame. Then scoop out the interior into a basin or crucible shape to form the cavity to hold the platinum. Be careful to construct the pouring spout so none of the molten platinum shall come in contact with the sheet iron frame.

The cover of this furnace is constructed similarly with pieces of caustic lime solidly fixed in the form made for it—although the projection below the metal form need not be so great. The pieces need not project more than 1 or 2 cm. below the rim of the metallic frame, and should be firmly secured in place. The cover should fit perfectly and evenly over the upper surface of the crucible. Scrape out some of the lime of the cover, forming a slight arch.

Two holes should be made in the cover; one for the introduction of the blowpipe (or two holes, if there is to be two blowpipes used), and one for the escape of the blowpipe gases. The blowpipe should penetrate the lime but slightly, and be so constructed that its position can be easily regulated and adjusted at will.

To get the oven to work, light the blowpipe and introduce it into the opening through the cover provided for the purpose. Regulate the flame and its position, and heat the furnace gradually. Introduce the platinum through an opening between the oven and the cover provided for that purpose, and so arranged that it may be closed. The platinum is cut into small pieces, which will melt almost instantly.

When the oven is full maintain the temperature, but slowly diminish the quantity of oxygen in order to overcome the 'spitting.'

To cast the platinum into ingots permit the temperature to be reduced just to the fusion point of the metal (1753° C.), or if the ingot mould is heated no lowering of the temperature is necessary. If too high a temperature is maintained before casting, there is some danger of melting the mould.

Once the oven is hot, a second fusion can proceed, which is always more rapid than the first. It will require from 60 to 70 litres of oxygen for each kg. of platinum, under a pressure of 12 to 15 cm. of mercury.

The large type of furnace may be made by dressing a block of limestone to the desired size and form and burning it, as previously indicated. Or adjust a block of limestone of the exact size and shape of the crucible desired into the sheet iron form and burn it to a caustic lime by means of the oxyhydrogen blowpipe. This method of burning will necessarily form cracks in cooling, due to contraction. These must be carefully filled with powdered quicklime.

To preserve the oven for future use, cover it thoroughly with powdered quicklime and put it in an air-tight compartment free from moisture. In this way it may be preserved indefinitely.

The casting of platinum is an operation which presents certain difficulties and which requires a great deal of practice. Generally the platinum is cast into ingots which can be easily flattened, being about as soft as copper. But to succeed in the operation it is indispensable to terminate the fusion in an atmosphere that is slightly reducing; that is, in an atmosphere slightly lacking in oxygen. This is for the purpose of removing the oxygen which the platinum has occluded, or dissolved. On the contrary, if the termination of the fusion has been done in an oxidizing atmosphere (where there is an excess of oxygen) the ingot blisters, or spits, and must be remelted.

In using an iron ingot mould let it oxidize on the inner surface. Rub it thoroughly with graphite, to successfully prevent the moulded metal from adhering. These moulds are so constructed that they may be stood up perpendicularly and held in place in such a way that they may, during the casting, be moved back and forth so that the metal is equally spread, and to also prevent any adhering of the metal to the side of the mould.

An ingot mould can be made by filling a sheet iron frame with pieces of quicklime carefully and properly adjusted, in which is scooped out a cavity of the proper size, which forms the mould. Again, an ingot mould may be made of graphite, or of cast iron lined with platinum and so constructed that the size and shape of the mould may be varied at will.

If the fusion is good, there will appear on the surface of the casting a slight depression; if, however, the casting is bad, a swelling on the surface is observed. In this case the metal is always blistered.

If, in place of platinum, it is wanted to melt iridium, it is indispensable to employ a lime furnace scooped in a block of pure caustic lime, and operated at a correspondingly high temperature (2300° C.). The fusion should be done as rapidly as possible to prevent losses, as certain oxides of iridium are formed which are relatively volatile. Sometimes during the fusion fumes are produced. These indicate the presence of ruthenium, due to previously faulty treatment.

SECRETARY'S OFFICE.

W. W. Thayer, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coördination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

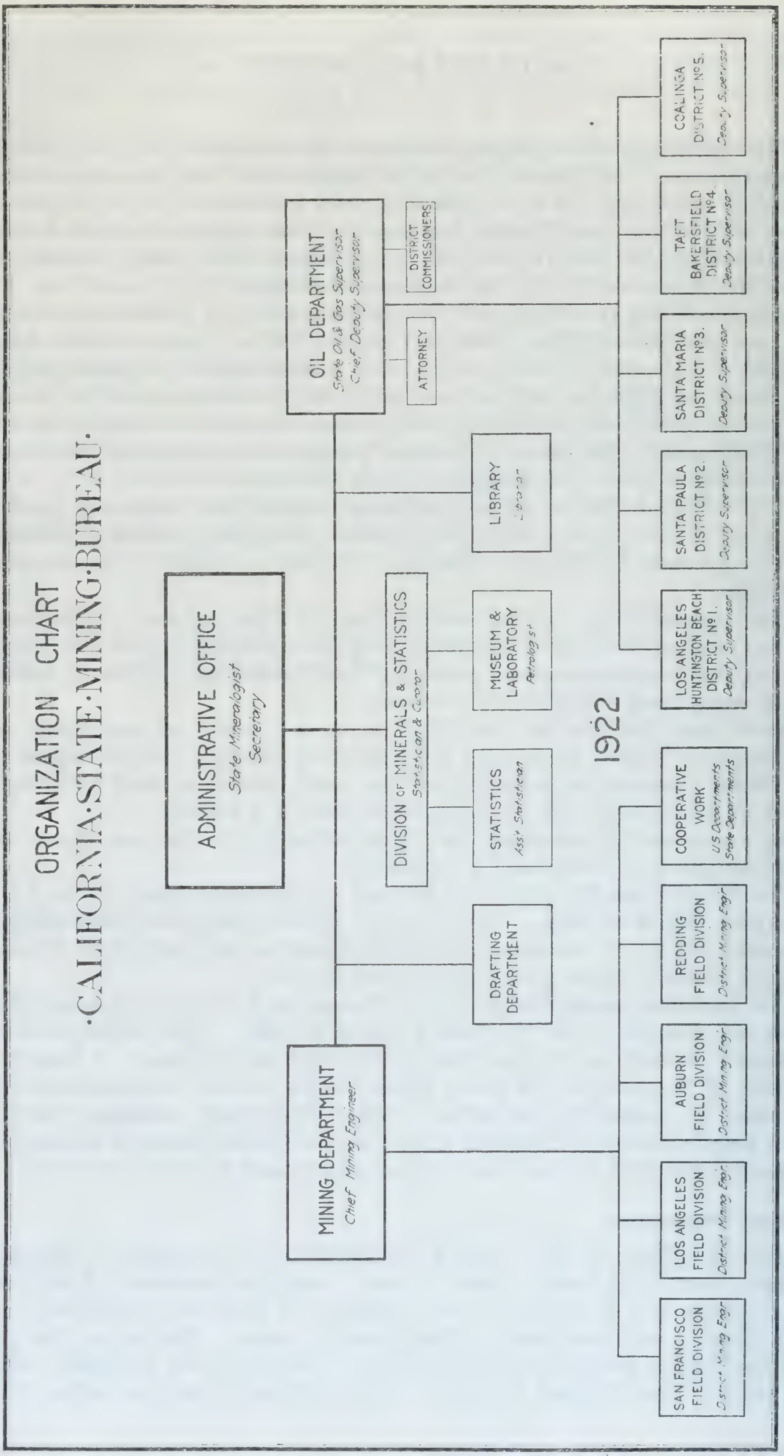
As a means of illustrating the organization of the Bureau, the accompanying chart is presented on page 174:

The Bureau headquarters are located in the third floor of the Ferry Building, San Francisco. Here are the offices of the State Mineralogist, executive offices of the mining and oil departments, statistical division, library, museum, laboratory, and drafting room.

The business management of the Bureau and the direction of all its work are conducted at the San Francisco office. This office is also a general information bureau open to the public at all times. A large proportion of the time of the State Mineralogist and all the technical staff is taken up answering inquiries, both written and personal, received from people who are interested in every conceivable phase of the mineral industry, many of whom live in other states and foreign countries.

Mining Department.

Branch offices of the mining department are located in Redding, Shasta County; Auburn, Placer County, and Los Angeles. Each office is in charge of a graduate mining engineer of practical experience, and each district engineer has a definite field to cover. Including the Central California district, which is handled from the San Francisco office, the state is thus divided into four distinct fields, in each of which there


ORGANIZATION CHART
·CALIFORNIA·STATE·MINING·BUREAU·
1922
ADMINISTRATIVE OFFICE
State Mineralogist
Secretary
MINING DEPARTMENT
Chief Mining Engineer
DRAFTING DEPARTMENT
DIVISION OF MINERALS & STATISTICS
Statistician & Curator
STATISTICS
Ass't Statistician
MUSEUM & LABORATORY
Petrologist
LIBRARY
Librarian
OIL DEPARTMENT
State Oil & Gas Supervisor
Chief Deputy Supervisor
ATTORNEY
DISTRICT COMMISSIONERS
SAN FRANCISCO FIELD DIVISION
District Mining Engr
LOS ANGELES FIELD DIVISION
District Mining Engr
AUBURN FIELD DIVISION
District Mining Engr
REDDING FIELD DIVISION
District Mining Engr
COOPERATIVE WORK
U.S. Departments
State Departments
LOS ANGELES HUNTINGTON BEACH DISTRICT No. 1.
Deputy Supervisor
SANTA PAULA DISTRICT No. 2.
Deputy Supervisor
SANTA MARIA DISTRICT No. 3.
Deputy Supervisor
TAFT BAKERSFIELD DISTRICT No. 4.
Deputy Supervisor
COALINGA DISTRICT No. 5.
Deputy Supervisor

is a representative of the Bureau readily accessible to the local mining public. This representative has his home in his district, and his interests are not those of a traveling investigator, but a citizen of the section in which he lives. He becomes personally acquainted with the miner and the prospector, a class of men who are often reticent and diffident, and after gaining their confidence his value to them and to the Bureau is greatly enhanced. Remote mines are brought into closer touch with the Bureau through the medium of the district engineer. His knowledge of routes of travel and familiarity with local conditions saves time and prevents lost motion, and the perspective he gains permits him to evaluate more correctly what he sees and hears. The district engineer has a working program somewhat as follows:

1. He is assigned the duty of preparing formal bulletins upon special subjects which are usually peculiar to some branch of mining in his district. The completion of a report of this kind may require months or even years. It demands exhaustive investigation and often research work.

2. Interwoven with and overlapping the work mentioned under number one comes the careful constant survey of the field to which the engineer has been assigned. He keeps advised as regards new discoveries, development of all mining properties, and all other details of the industry as far as it is possible to do so.

3. The district engineer is the servant of his local mining public, just as the State Mineralogist is the servant of all the people of the state. This has been mentioned last, but as a matter of fact a call for any assistance that a Bureau representative is authorized to render takes precedence over all else. Other work is set aside until such a call has been responded to and cared for to the best of his ability.

Petroleum Department.

Conservation of the oil and gas resources of California has for over six years been provided for by State supervision. The most obvious and serious cause of waste in California oil fields has been due to waters which flood productive formations, consequently legislation has been aimed directly at that feature.

The department of petroleum and gas was established by law August 9, 1915. Under this law the State Mineralogist is authorized to appoint as oil and gas supervisor an engineer or geologist experienced in the development of petroleum. This office has supervision over the drilling, operation, maintenance and abandonment of oil and gas wells. The staff of the petroleum department is composed entirely of men technically trained as mining engineers, civil engineers or geologists.

For administrative purposes branch offices of the petroleum department, each in charge of a deputy oil and gas supervisor, are maintained in Coalinga, Bakersfield, Taft, Santa Maria, Santa Paula, Los Angeles and Huntington Beach.

The business of the department concerning oil operations is transacted in the branch offices, between the field representatives of the companies and the deputy supervisor in charge of the district. At each field office there are models, maps, cross-sections, and all the various data used in determining the specifications to be applied to any well.

The department of petroleum and gas is supported financially by assessment levied directly upon oil land and oil and gas produced, and is independent in this regard of the varying appropriations which support the other activities of the Bureau. Up to date the amount expended has been less than one mill per barrel of oil produced. The cost of State supervision, looked at from another angle, has averaged about $40 per well which has come under the Bureau's supervision. When it is remembered that the average cost of drilling an oil well in California is not less than $40,000, the insignificance of this tax is emphasized.

A detailed description of the operation of the oil and gas law would occupy the space of a small pamphlet, but the records are available for the inspection of any one interested, and it is confidently stated that the general plan of supervision, based upon scientific and technical methods, has unquestionably demonstrated its usefulness and will undoubtedly be retained in California.

Division of Minerals and Statistics.

The statistical section keeps an up to date list of all owners and operators of mineral deposits and mines in the state. By correspondence and personal visits, production data are obtained and published annually. Not only is such information of well-recognized value, but buyers and consumers are continually referred to producers through the medium of the Bureau's records, in a direct and satisfactory manner. By means of an addressograph and other modern office equipment, the vast amount of detailed work required to make a recurring statistical inquiry dependable and authentic is efficiently carried on.

In the laboratory free determination is made of specimens sent in from any point in the state. This service is widely used and is of particular value to the man of limited means who may have discovered minerals with which he is not familiar. Instead of being forced to pay to have a sample analyzed. which may very possibly be valueless from a commercial standpoint, he may first be advised by the Bureau as to what the possibilities are in this regard.

The museum, which has gradually been built up during the past forty years, contains approximately 20,000 specimens of ores, wall rocks and minerals, mostly from California, but in part from many other states and foreign countries. Situated as it is in the Ferry Building, which is a union depot and gateway to San Francisco, for hundreds of thousands of persons daily, the museum attracts a great deal of attention and undoubtedly is a direct aid in developing the mineral industry of the state.

For example: When the call came for chromium and manganese—in 1917—the museum was thronged with men who came to scrutinize the minerals containing those metals, so that they would be able to prospect with greater intelligence.

Library.

The library, which is freely available to all for reference, contains approximately five thousand books, most of which relate to mining and engineering, and it also contains a file of local newspapers from most of the mining towns of California, as well as a file of the principal technical magazines published throughout the United States.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Oil Field Map No. 2, Santa Maria, Including Casmalia and Lompoc. Revised to April 1, 1922.

Oil Field Map No. 3, Santa Maria, Including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield. Revised to April 1, 1922.

Oil Field Map No. 22, Portion District No. 3, Showing Boundaries of Oil Field. Santa Barbara County. Revised to April, 1922.

Colored Map of State, Showing the Generalized Classification of Land with Regard to Oil Possibilities. (Issued also with Bulletin No. 89, 'Petroleum Resources of California.')

Summary of Operations—California Oil Fields, January, 1922, Vol. 7, No 7.

Mining in California, March, 1922 (monthly), Vol. 18, No. 3.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications distributed during the month of March, 1922:

Publications	Number Distributed
Report XIV State Mineralogist	3
Report XVII State Mineralogist	10
Mines and Mineral Resources of Del Norte, etc.	2
Mines and Mineral Resources of Fresno, etc.	3
Mines and Mineral Resources of Imperial, etc.	4
Mines and Mineral Resources of Alpine, etc.	3
Mines and Mineral Resources of Butte, etc.	4
Mines and Mineral Resources of El Dorado, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	3
Mines and Mineral Resources of San Bernardino, etc.	4
Mines and Mineral Resources of Nevada County	2
Mines and Mineral Resources of Plumas County	8
Mines and Mineral Resources of Sierra County	9
Mines and Mineral Resources of Shasta, etc.	1
Bulletin No. 6, California Gold Mill Practices	4
Bulletin No. 23, Copper Resources of California	2
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	8
Bulletin No. 46, General Index to Publications of the State Mining Bureau	1
Bulletin No. 50, Copper Resources of California	2
Bulletin No. 72, Geologic Formations of California	13
Bulletin No. 75, Mining Laws, United States and California	70
Bulletin No. 76, Manganese and Chromium in California	3
Bulletin No. 77, Catalogue of Publications of the California State Mining Bureau, 1880–1917	3
Bulletin No. 78, Quicksilver Resources of California	11
Bulletin No. 85, Platinum Resources of California	9
Bulletin No. 89, Petroleum Resources of California, with Special Reference to Unproved Area	717
Bulletin No. 90, California Mineral Production for 1920	100
County Maps and Registers of Mines	25
Geological Map of California, mounted	19

Publications.	Number Distributed
Preliminary Report No. 8, Review of Mining in California During 1921	200
Mining in California (Monthly) Vol. 18, No. 1	210
Mining in California (Monthly) Vol. 18, No. 2	2140
Mining in California (Monthly) Vol. 18, No. 3	2360
Colored Map Accompanying Bulletin 89, Showing Generalized Classification of Land with Regard to Oil Possibilities	20
Oil Field Maps	479

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file, which includes reports on some 7500 mines and mineral properties in California. Also, there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 976 letters were received and answered. They are practically all requests for information, and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting Room.

This is purely and simply a work shop, and is the only branch of the Bureau that is not primarily at the service of the public. In the drafting room well logs, maps, sketches, etc., are prepared for the many publications and reports which are under way at all times.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

California produces commercially at least fifty different mineral substances, with a total annual value of nearly $250,000,000. There are several thousand operating properties, including mines, quarries, oil and gas wells, mineral springs, gravel pits, mills and smelters; hence, the task of compiling accurate and dependable statistics covering their activities is not a simple one.

Blank report forms for the 1921 data were mailed to the operators, in January, 1922, followed by a 'second request' in March to those who had not by that time responded. At present writing (April 15), the majority of the reports are in hand, and a 'third request' is being made to the few remaining delinquents. Data for several substances are now complete and have been compiled, being presented herewith.

The data at hand indicate that there was no production in California in 1921 of the following substances, which have at one time or another in the past been on the active list here: Antimony, bismuth, cadmium, mica, molybdenum, nickel, nitrates, serpentine, sulphur, tungsten, tin, vanadium.

ASBESTOS.

Bibliography: State Mineralogist Reports, XII, XIII, XIV, XV, XVI, XVII. Bulletin 38. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531–533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617–625; 670–677.

In 1921 a total of 410 tons of asbestos fibre, valued at $19,275, was shipped from Fresno, Monterey, Nevada, San Benito, Shasta and Siskiyou counties, by a single operator in each. This was a considerable increase over the 66 tons, worth $2740, produced in 1920; though, as yet, California's asbestos industry is small as compared to some other North American localities. The above shipments were all of chrysotile asbestos, except the small tonnage from Shasta County, which was of the amphibole variety.

The Monterey County product was of spinning-grade fibre, as was also a portion of that from Nevada County. The bulk of the yield was of short-fibre mill grade, and was utilized mainly in magnesite-cement stucco, steam-pipe covering, flooring, composition shingles and roofing paper. The outlook for asbestos becoming an important industry in California is promising. There are extensive serpentine areas in the Coast ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada, which localities came to the fore in yielding chromite during the war period. As chrysotile asbestos is a fibrous form of serpentine, these areas are all within the range of possible asbestos producers. In addition to the above-mentioned producing counties, chrysotile of good-quality fibre, though short, has also been found in Calaveras, Lake, Napa and Trinity counties. Reports of the U. S. Geological Survey also confirm the promising quality of the California fibre. Milling plants are now being built on at least three asbestos deposits here, which expect soon to be in commercial operation: Pacific Asbestos Corporation, near Copperopolis, Calaveras County; Liberty Asbestos Company, near Coalinga, Fresno County; California Asbestos Mining Company, near Hernandez, San Benito County. The mill of the Sierra Asbestos Company at Washington, Nevada County, built several years ago, continues in operation except during the winter months.

Classification and Characteristics.

The word asbestos (derived from the Greek, meaning incombustible) as used here includes several minerals, from a strictly mineralogical standpoint. There are two main divisions, however: Amphibole and chrysotile. The fibrous varieties of several of the amphiboles (silicates chiefly of lime, magnesia and iron), notably tremolite and actinolite, are called asbestos. Their fibres usually lie parallel to the fissures containing them. Amphibole asbestos possesses high refractory properties, but lacks strength of fibre, and is applicable principally for covering steam pipes and boilers. Chrysotile, a hydrous silicate of magnesia, is a fibrous form of serpentine, and often of silky fineness. Its fibres are formed at right angles to the direction of the fissures containing them. Chrysotile fibres, though short, have considerable strength and elasticity, and may be spun into threads and woven into cloth. To bring the highest market price asbestos must needs have a combination of properties, *i. e.,* length and fineness of fibre, tensile strength and flexibility—all combined with infusibility; and determination of the same can only be made by practical tests or in the laboratory. In the two years prior to 1914, chrysotile asbestos was sold at prices ranging from $10 to $250, according to length of fibre and quality. Almost fabulous figures were reached for extra-long spinning fibre in 1918, and proportionate levels for other grades. Prices have since receded somewhat from those high levels; but statements issued by some of the important marketing concerns indicate that the unprofitable low prices of 1912–1914 will not again obtain. The extreme high values quoted for extra long-fibre material are misleading to one looking for average values in the industry. In Canada the shorter, 'mill-stock' grades constitute over 95% of the merchantable asbestos, and are quoted at present at approximately $15 to $150 per ton.

The poorer grades which are unsuitable for weaving are used in the manufacture of steam packing, furnace linings, asbestos brick, wall plasters, paints, tiling, asbestos board, shingles, insulating material, magnesite-stucco, etc. The better grades are utilized in the manufacture of tapestries of various kinds, fireproof theater curtains, cloth, rope, etc.

A very important development of the asbestos industry is the rapidly increasing demand for the lower-grade material, on account of the numerous diversified uses to which asbestos products are being put, in almost every branch of manufacture. This fact means that many deposits of asbestos will become commercially important even though of the shortest fibre.

It has been found that not only does an asbestos wall-plaster render the wall so covered impervious to heat, but that in rooms which have given forth an undesirable echo this evil has been absolutely removed. Asbestos pulp mixed with magnesite-cement has been experimented with; and roofing, flooring and other building material of the most satisfactory sort are now being manufactured therefrom.

Asbestos Grading.

On account of the large numbers of inquiries which have recently been received by the Bureau relative to the marketing of asbestos it has been deemed advisable to reprint the following statement, which appeared in the Engineering and Mining Journal of March 25, 1922:

"The length of asbestos fiber of different grades as sold in America varies with the mine producing the crude. No two mines produce exactly the same grades, although they use the same marks at times, which is also misleading and causes confusion.

"No general agreement regarding the classification of asbestos exists among producers which specifies what every grade of asbestos shall include and designate. Physical tests are relied upon to a much greater extent than chemical, because in the use of the mineral its physical properties are the more important. Such simple characteristics as length of fiber, color and tensile strength are of paramount importance and control the price for which asbestos can be sold. The Canadian mines generally employ a screen test to determine the grade of an asbestos product, and use a set of shaking-screens consisting of four separate trays about 16 x 26 x 5 in. The No. 1, or top screen, sizes to ½-in. mesh; the No. 2, or second screen from the top, is screened to ¼-in. mesh; No. 3, the third tray, is screened to 1/10-in. mesh, and No. 4, the bottom tray, receives the product falling through the first three screens. A suitable mechanical device shakes the set of screens 300 times per minute with a small throw—1½ in.

"In the ordinary test one pound of asbestos fiber is placed on the top tray and the screen mechanically shaken for two minutes, during which time the mineral naturally distributes itself on the various screens according to size. At the end of the test the amount of fiber remaining upon each screen is carefully weighed, and the result is expressed in a formula that always contains four terms with a hyphen between each. Thus the designation 0-9-5-2 shows that no fiber remained upon the top or coarsest screen, 9 oz. on No. 2 screen, 5 oz. on No. 3 and 2 oz. on the bottom tray. Of course the sum of the four should add to 16 oz.

"The principal grades of asbestos are No. 1 Crude, No. 2 Crude, long spinning fiber, medium spinning fiber, magnesia and compressed sheet fiber, shingle stock, paper stock, cement stock and floats, which are the grades used in our market quotations. Crude No. 1 is asbestos greater than one-half inch in length. It should be silky and of sufficient tensile strength to permit its use for making asbestos yarn, tape, cloth, carded fiber and other asbestos textiles. Owing to the different characteristics of asbestos produced by the several centers in Quebec, a variation will exist among the grades ordinarily sold in this class.

"Crude No. 2 asbestos is generally referred to as mineral that has not been milled and which is less than ½ in. long. It must be of good tensile strength. Frequently it is mixed with Crude No. 1 in the manufacture of asbestos textiles. Color is also a consideration in determining the price at which it can be sold. Although some companies produce what they term a No. 3 Crude, this classification is not generally recognized by the trade as standard.

"Long spinning fiber used in asbestos textile manufacturing tests anywhere from 4-7-4-1 down to 1-9-4-2, but the standard tests may be taken as 4-7-4-1 and 2-8-4-2.

"Medium spinning fibers are generally required to test 0-8-6-2, and may be mixed with the better grades for textile manufacture.

"Magnesia and compressed sheet fiber averages 0-5-8-3. These fibers are used in the manufacture of magnesia pipe covering and compressed sheet packing.

"There are various grades of shingle stocks, each mine having a different method of determining what constitutes a shingle fiber. The best-known material, however, tests 0-1½-9½-5. Some mines make 0-3-9-4; 0-2-10-4; 1-11½-3½, although the standard shingle stock calls for a test of 0-1½-9½-5. This material, as its name implies, is used in the manufacture of asbestos shingles, corrugated asbestos lumber, and switchboard panels, and is used in conjunction with portland cement.

"Paper stock tests are the nearest standardized tests among the miners. They test either 0-0-10-6 or 0-0-11-5. The common designation for paper stock is 'X.X.' fiber. This material is used for making asbestos paper and millboard and is sometimes mixed with the longer grades of shingle stock.

"Paper stock tests on the average 0-0-10-6 and is used in making asbestos paper or mixing with shingle stock.

"Cement stock, a cheap grade of merchantable asbestos, may test 0-0-5-11 or 0-0-6½-9½. It is used in the manufacture of asbestos boiler and roofing cements and for making millboard.

"Floats or shorts are sold on color and used in the manufacture of flooring. The grade is usually pulpy or sandy in nature.

"No notice is taken of chemical analysis. Iron in asbestos is detrimental, especially if for electrical purposes. The analysis of asbestos depends on the district in Canada from which the material comes, and varies to a considerable extent. There is no special use for asbestos with an iron alumina basis; in fact, this is a detriment to the material.

"Canadian asbestos is not washed before being bagged and sold, so far as we can ascertain. In early issues of Engineering and Mining Journal-Press we shall publish two articles with a more extended description of the occurrence, mining and preparation of asbestos and the marketing of the product.

"We are indebted to B. Marcuse, president of the Asbestos Crude & Fibre Corporation, and of the Asbestos Crude & Fibre Mining Corporation, Ltd., for valuable aid in preparing the above statement."

Quotations according to the same authority were:

Crude No. 1	$800	to	$1000
Crude No. 2	500	to	750
Spinning fibres	200	to	300
Magnesia and compressed sheet fibres	100	to	175
Shingle stock	70	to	120
Paper stock	40	to	50
Cement stock	12.50	to	17.50
Floats	6	to	10

All per short ton f. o. b. mines, Quebec, Canada.

The bulk of the world's supply of asbestos has, for many years, come from Canada. More recently, shipments from South Africa are becoming important. In the United States, long-fibre chrysotile is being obtained in Arizona which is the equal, if not superior, in quality to the Canadian.

Value and Production in California.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value
1887	30	$1,800
1888	30	1,800
1889	30	1,800
1890	71	4,260
1891	66	3,960
1892	30	1,830
1893	50	2,500
1894	50	2,250
1895	25	1,000
1896		
1897		
1898	10	200
1899	30	750
1900	50	1,250
1901	110	4,400
1902		
1903		
1904	10	162
1905	112	2,625
1906	70	$3,500
1907	70	3,500
1908	70	6,100
1909	65	6,500
1910	200	20,000
1911	125	500
1912	90	2,700
1913	47	1,175
1914	51	1,530
1915	143	2,860
1916	145	2,380
1917	136	10,225
1918	229	9,903
1919 } 1920 } *	131	6,240
1921	410	19,275
Totals	2,686	$126,975

*Under Unapportioned.

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII. Bulletin 38.

The output of crude barytes during 1921 was 901 tons, valued at $4809, as compared with the 1920 production of 3029 tons, worth $20,795. The principal use for barytes is in the paint industry; also in certain rubber articles. For the former purpose, the material should show pure white after grinding. Lithophone is a chemically prepared white pigment containing about 70% barium sulphate and 30% zinc sulphide, and is one of the principal constituents of 'flat' wall paints now so extensively used in office buildings and hospitals, replacing both paper and calcimine wall finishes. Minor uses are in tanning of leather, manufacture of linoleum, paper and rope, and sugar refining. Most of the output of California is utilized in the manufacture of lithophone and blanc fixe.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). The 1915 output was the first commercial production of the carbonate in the United States of which we have record. In 1916–1920, some tonnage of barytes came from a deposit opened up on Fremont's Peak, Monterey County, near the line of San Benito County; in 1919–1921, shipments were made from Nevada County. Shasta County is in the list for 1921.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value
1910	860	$5,640
1911	309	2,207
1912	564	2,812
1913	1,600	3,680
1914	2,000	3,000
1915	410	620
1916	1,606	5,516
1917	4,420	$25,633
1918	100	1,500
1919	1,501	18,065
1920	3,029	20,795
1921	901	4,809
Totals	17,300	$94,277

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV.

The manufacture of asphalt at the oil refineries has almost eliminated the industry of mining bituminous rock, but small amounts of the latter are still used occasionally for road dressing. The production during 1921 from quarries in Santa Cruz and Santa Barbara counties was 8298 tons, valued at $43,192, compared with 5450 tons and $27,825 in 1920.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1906	16,077	$45,204
1888	50,000	257,000	1907	24,122	72,835
1889	40,000	170,000	1908	30,718	109,818
1890	40,000	170,000	1909	34,123	116,436
1891	39,962	154,164	1910	87,547	165,711
1892	24,000	72,000	1911	75,125	117,279
1893	32,000	192,036	1912	44,073	87,467
1894	31,214	115,193	1913	37,541	78,479
1895	38,921	121,586	1914	66,119	166,618
1896	49,456	122,500	1915	17,789	61,468
1897	45,470	128,173	1916	19,449	66.561
1898	46,836	137,575	1917	5,590	18,580
1899	40,321	116,097	1918	2,561	9,067
1900	25,306	71,495	1919	4,614	18,537
1901	24,052	66.354	1920	5,450	27,825
1902	33,490	43,411	1921	8,298	43,192
1903	21.944	53,106			
1904	45,280	175.680	Totals	1,168,201	$3,591,883
1905	24,753	60,436			

COAL.

Bibliography: State Mineralogist Reports VII, XII, XIII, XIV, XV, XVII. U. S. G. S., Bulletins 285, 316, 431, 471, 581; An. Rep. 22, Pt. III. See pp. 152–157 *ante*, for detailed list.

Coal has been produced in California since as early as 1860, and until the development of crude oil was an important factor in the mineral industry of the state. As most of it is lignite, the quality is generally poor as compared with other coals on the Pacific Coast markets. However, in competition with fuel oil, coal of all grades has had to take second place. Besides the counties noted below as showing a commercial production, workable bodies of coal are also known in several others, including Alameda, Amador, Contra Costa, Mendocino, Shasta and Siskiyou. Some coal has also been produced, in the past, in Fresno and Orange counties.

During 1921, production was reported from Monterey and Riverside counties totaling 12,467 tons, valued at $63,578. The increase over the 1920 figures is due to the reopening of the Stone Canyon Mine in Monterey County, a portion of the tonnage there having been utilized in the reopening before commercial shipments were resumed in the latter part of the year. The Riverside County output was utilized only for camp purposes at the mine.

Tests have been made by the U. S. Geological Survey[1] on some of the Ione, Amador County, lignite (because of its resemblance to some oil shales), to determine if it will yield oil on destructive distillation. Up to 62 gallons of oil per ton was obtained and also 18 pounds of ammonium sulphate as a by-product. The latter is valuable as a fertilizer.

---

[1] U. S. Geol. Surv., Press Bulletin No. 402, March, 1919.

Analyses showed: 16% fixed carbon, 31% volatile matter, 46% moisture, 7% ash; and the heating value is 6060 British thermal units.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later, the Tesla Mine in Corral Hollow, Alameda County, was an important producer for a few years. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value
1861	6,620	$38,065
1862	23,400	134,550
1863	43,200	248,400
1864	50,700	291,525
1865	60,530	348,048
1866	84,020	483,115
1867	124,690	716,968
1868	143,676	826,137
1869	157,234	904,096
1870	141,890	815,868
1871	152,493	876,835
1872	190,859	1,097,439
1873	186,611	1,073,013
1874	215,352	1,238,274
1875	166,638	958,169
1876	128,049	736,282
1877	107,789	619,787
1878	134,237	771,863
1879	147,879	850,304
1880	236,950	1,362,463
1881	140,000	805,000
1882	112,592	647,404
1883	76,162	380,810
1884	77,485	309,950
1885	71.615	286,460
1886	100,000	300,000
1887	50,000	150,000
1888	95,000	380,000
1889	121,280	288,232
1890	110,711	283,019
1891	93.301	204.902
1892	85,178	209,711
1893	72,603	$167,555
1894	59,887	139,862
1895	79,858	193,790
1896	70,649	161,335
1897	87,449	196,255
1898	143,045	337,475
1899	160,941	420,109
1900	176,956	535,531
1901	150,724	401,772
1902	88,460	248,622
1903	93,026	265,383
1904	79,062	376,494
1905	46,500	144,500
1906	24,850	61,600
1907	23,734	55,849
1908	18,496	55,503
1909	49,389	216,913
1910	11,033	23,484
1911	11,047	18,297
1912	14,484	39,092
1913	25,198	85,809
1914	11,859	28,806
1915	10,299	26,662
1916	4,037	7,030
1917	3,527	7,691
1918	6,343	16,149
1919	2.983	8.203
1920	2,078	5,450
1921	12,467	63,578
Totals	5,177,125	$22,945,488

The tonnages in the above table for the years 1861-1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93-94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

FLUORSPAR.

Bibliography: Report XVII, Bulletin 67.

Fluorspar is used as a flux in steel and iron smelting, and in the production of aluminum. It is also utilized in the manufacture of hydrofluoric acid, glass, porcelain, enamels and sanitary ware.

[1] "The market for the bulk of the fluorspar sold in the United States depends on the steel industry, and the demand fluctuates with the rise and fall in the production of steel. Gravel spar is consumed as a flux in basic open-hearth steel furnaces and to a smaller extent in other metallurgical operations. In both 1914 and 1915 the sales of gravel spar constituted between 83 and 84 per cent of the total marketed output of domestic fluorspar, and in 1916 it was nearly 86 per cent. Fluorspar is used also as a flux in iron blast furnaces, iron foundries, and in gold, silver, copper and lead smelters; in the manufacture of fluorides of iron and manganese for steel fluxing and of sodium fluoride for wood preservation[2]; in the manufacture of glass, enameled and sanitary ware, and of hydrofluoric acid; in the electrolytic refining of

---

[1] Burchard, E. F., Fluorspar and cryolite in 1916: U. S. Geol. Surv., Min. Res. of U. S., 1916, Part II, p. 315, 1917.

[2] Teesdale, C. H., Use of fluorides in wood preservation: Wood Preserving, vol. 3, No. 4; vol. 4, No. 1. (Reprint, 9 pp.)

antimony and lead, and in the production of aluminum. Other miscellaneous uses of fluorspar that have been reported are as a bonding for constituents of emery wheels, for carbon electrodes, in the extraction of potash from feldspar, and in the recovery of potash in Portland cement manufacture. The last use depends on the suitability of calcium fluoride as a reagent for increasing the volatilization of potassium salts from the clinker and the regeneration of the reagent from the dust collected.[1] "

In California, deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but up to 1917 no commercial production had resulted.

In 1917–1918, a total of 79 tons valued at $991 was shipped from Riverside County, but none since. In 1921, at the King Mine under development near Afton, San Bernardino County, some fluorspar was mined but not shipped before the close of the year. Field examinations have indicated a considerable deposit there of merchantable spar.

Present quotations (Engineering and Mining Journal-Press, New York, April 8, 1922) are: Lump, 85% calcium fluoride, and not over 6% silica, @ $20 per ton; gravel, $17.50. Lump, $12.50–$13.50, f. o. b. New Mexico.

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletin 67. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite has been produced from time to time in the State, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which are not high grade, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Low-grade ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price. Improved methods of graphite milling adopted promise to increase largely the production of flake of better grade.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory.

Among the newer uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material until the best quality crystalline variety ordinarily ranges as high as $200 per ton. The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Since the close of hostilities in Europe, prices have declined to nearly the pre-war level; and imports have been resumed from Ceylon, Canada, Madagascar, Mexico and Korea, of a total of 7496 tons valued at $452,076 in 1921.

---

[1] Treanor, John, Potash from cement at the Riverside Portland Cement Co.: Met. and Chem. Eng., June 15, 1917, pp. 701–703.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1921 a slightly decreased production was reported from Los Angeles County. It was concentrated from a disseminated ore, and was used for paint, foundry facing, and lubricants. As there was but a single operator, the figures are concealed under the 'Unapportioned' item. For 1922 a second plant is expected to join the producing list, also in Los Angeles County. The production, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903	-----	-----
1913	2,500	25
1914	-----	-----
1915	-----	-----
1916	29,190	2,335
1917	*770,000	37,225
1918		
1919		
1920		
1921	*	*
Totals	1,013,690	$45,745

*Concealed under 'Unapportioned,' on account of a single producer.

IRON ORE.

Bibliography: State Mineralogist Reports II, IV, V, X, XII, XIII, XIV, XV, XVII, XVIII. Bulletins 38, 67. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

Iron ore to the amount of 1970 tons, valued at $12,030, was produced in California during the year 1921, and utilized for foundry flux and in steel refining at open-hearth plants. This is a decrease from the 5975 tons and $40,889 of 1920, which was the largest amount for a single year since 1883.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited on account of our having no economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction. Further developments along the line of electrical smelting, or discoveries making available our petroleum fuel, for iron reduction, would lead to considerable increase of iron mining in California. For the present, at least, the most feasible possibilities would seem to lie in utilizing our iron resources in the preparation of the various alloys such as ferro-chrome, ferro-manganese, ferro-molybdenum, ferro-silicon and ferro-tungsten, by means of the electric furnace. California possesses commercial deposits of ores of all the metals just enumerated.

The subject of establishing an iron industry on the Pacific Coast has been under discussion at various times, as indicated by the bibliography given above. We quote herewith portions of two contributions that appeared in 1921, containing data of particular interest to California, especially on cost and consumption figures:

[1] "COKE. The vital factor in successful blast-furnace smelting is coke. Iron ore can be brought from great distances cheaply, but it is costly to transport coke. Coke represents one-third of the weight and one-half of the volume of the ordinary blast-furnace charge. Normally from 20 to 30 per cent of the cost of production is due to coke. There are two outstanding characteristics that the coke must have. First, it must be cheap, and, second, it must have the mechanical strength to support the weight of the charge and sufficient hardness to resist too rapid solution by the ascending gases.

"* * * Coke should not be moved great distances, and Utah coke should not be shipped to California. The smelting center should be near the coke supply in British Columbia or Washington.

"IRON ORE. The presence of iron ore near the smelting locality is not so important as is the presence of coke. Iron ore can be shipped as ballast cheaply from great distances. * * *

"There is a vast supply of high-grade hematite ore in southern California in the Eagle Mountains, of Riverside County, and in the Cave Canyon district and in the Providence Mountains of San Bernardino County. These ores are rather far inland, but fortunately not far from a railroad. It is probable that other ores nearer tidewater can be obtained at less expense.

"LIMESTONE. * * * Sufficient limestone to maintain a plant in southern California may be obtained in San Bernardino County.

"REFRACTORIES. Clay for refractory purposes is available * * *.

"MARKET. Much difference of opinion exists as to the scope of the market for iron and steel on the Pacific Coast. It is difficult to obtain reliable data. The customers are scattered over such an extensive area, and their purchases are so variable in amount and kind, that it is almost impossible to obtain information from them. * * * However, in this discussion the important factor is not so much what the present consumption is, but what the consumption would be if cheaper iron and steel were available.

"No pig-iron is produced on the Pacific Coast. Most of that used comes by rail from the East. Small amounts arrive from time to time from China and occasionally from Great Britain and elsewhere. Two hundred tons of pig-iron is consumed daily, practically all of it being used for making gray-iron castings. With cheaper pig-iron the present output of castings will be increased, and thus the market for foundry iron will become larger.

"The production of steel in California, Oregon, Washington and Utah is 1000 tons per day. Scrap-iron and scrap-steel are used almost entirely because they are cheaper than pig-iron. Cheap pig-iron would replace a large portion of this scrap. The steel-makers would like to use part pig-iron in the charges to the furnaces because at times scrap is hard to get, its cost increases with the demand, and a mixture of part scrap and part pig-iron is more desirable from the standpoint of melting.

"Although the total consumption of steel on the coast is large, it consists of many different sizes and shapes, without a large continuous consumption of any one. Steel rolling-mills are complex and expensive, and to be operated profitably must have a large production. It would be impossible to construct and operate a mill to produce so large an assortment of sizes and shapes on the small scale necessary to prevent flooding the Pacific Coast market. Those products must be made for which there is a large steady demand or which can be made by the same machinery. An example of a product for which there is sufficient demand to take the output of a modern rolling-mill is tin-plate. The consumption of tin-plate and tin cans in California, Oregon, Washington, British Columbia and Alaska amounts to 150 tons daily, and the amount exported through Pacific ports to 100 tons. Hence, a market exists for 250 tons daily, and it is reasonable to suppose that a portion of this market could be absorbed by a producer on this coast. * * *

"Much has been said in the past regarding the importation to this country of cheap Chinese pig-iron. It is true, Chinese pig-iron has been laid down on the Pacific Coast for less than pig-iron from eastern United States could be. But there is no danger of any great competition from this source. The so-called cheap Chinese labor is not cheap when reduced to terms of output per dollar. Coke is available in China, but it is expensive. Considering all things, the cost of producing pig-iron in China is comparatively high; and China, rather than engaging in the production and exportation of iron, will become an active consumer, particularly of steel products.

* * * * * * *

"SMELTING PROCESS. The size and type of smelting operation depends upon the size and the nature of the market. If there is a large enough outlet for pig-iron, the blast-furnace process will be used, because it is the standard and, of course, the cheapest. The high cost of coke and the fact that the market for pig-iron extends over the vast area of the Pacific Coast states may make the cost of production of iron so large that the present margin due to the high cost of transportation will be eliminated.

---

[1] Williams, C. E., Factors in the production of iron and steel on the Pacific Coast; Min. & Sci. Press, Vol. 123, pp. 94–96, July 16, 1921.

* * * * * * *

"Electric smelting has been suggested as a substitute for the blast-furnace for the following reasons: (1) Good coke is not essential and the quantity of fuel needed amounts to only one-third that needed in the blast-furnace; (2) small-scale production is possible; (3) there is cheap power, or at least cheap potential power, along the coast. Were all these reasons facts, electric smelting would be a possible substitute. But power is not cheap, at least from the standpoint of electric pig-iron, and will not be cheap for many years to come."

"Another process has been proposed, a substitute for both the blast-furnace and the electric-furnace processes and a sort of combination of the two. It is the preparation and melting of sponge-iron. Briefly, the process consists of grinding and purifying the ore by magnetic concentration, mixing it with a low-grade fuel, heating for two or three hours at a temperature of about 950° C., cooling and passing the mixture through a magnetic separator. Metallic iron in a very finely divided condition, free from impurities, is obtained in the concentrate. This product is called sponge-iron. It is then melted in the presence of carbon in an electric furnace, by which means various grades of iron and steel can be made at will. From a theoretical standpoint this process has some promise. It will utilize fuel of poor quality and can be used with impure ores. The fact that various grades of iron and steel can be made makes it adaptable to the conditions existing on the Pacific Coast. For example, to large centers that have near them deposits of iron ore and cheap fuel and that consume both foundry iron and steel ingots, this process would be peculiarly adapted. Sufficient experimentation has not been done to point to either success or failure."

In discussion of the foregoing, the following was contributed:

[1] "The establishment of an iron and steel plant on the coast has become an absolute necessity, especially a blast-furnace plant for the manufacture of pig-iron. Quite recently I was commissioned by British and American interests to make a personal investigation of the market for pig-iron on the coast. I interviewed practically every user of pig-iron, also the shipbuilding and engineering works from Vancouver to Los Angeles, and I am satisfied there is a market on the coast for at least a thousand tons of pig-iron per day, and probably considerably more. The foundries in Oregon alone use 300 tons per day.

"In discussing the question of pig-iron with the scrapmill owners of San Francisco and Los Angeles, they assured me that the five mills would undertake to enter into a firm contract to take 500 tons per day. They are operating entirely on steel and iron scrap, but would prefer at least 40 per cent pig-iron if they could secure it anywhere near the price of scrap, which was then $32 per ton in San Francisco. The price of pig-iron was then $65 to $80 per ton. The prevailing price of pig-iron before the war was from $27.50 to $32.50 for Scotch pig, known as Eggleton No. 2, and during my thirty years' residence in British Columbia I have only once seen pig-iron under $25 per ton.

"Regarding the cost of producing pig-iron on the coast from our native magnetic ores: In 1910 the Canadian federal government sent out to British Columbia Mr. Lindeman, an eminent Norwegian mining engineer and metallurgical expert, to look into the cost of producing pig-iron by the blast-furnace method, and he estimated that notwithstanding the higher wages and cost of other material prevailing at the time, pig-iron could be produced from British Columbian ores at a cost not exceeding $16 per ton. Siever also reported from $12.50 to $15. The high iron-content of our ores and their lack of impurities reduces the cost of producing pig-iron.

* * * * * * *

"Regarding competition from pig-iron made in China, I agree with Mr. Williams that we have nothing to fear from this source. They have not yet made a foundry pig-iron suitable for our market. Moreover, China will not only absorb all she can make herself, but will be a large importer of the products of iron and steel for the next fifty years at least.

"Dealing with Mr. Williams' remarks regarding the total consumption of steel on the coast, it is true that it consists of many different sizes and shapes without perhaps a large continuous consumption of any particular size, and I fully agree with him that it would be impracticable to construct and operate a single mill to produce all this assortment of sizes and shapes, and that those products must be made for which there is a steady demand. He mentions tin-plate as a product for which there is sufficient demand to take the output of a modern rolling-mill, and states that the consumption of tin-plate on the coast amounts to 150 tons per day. He is more than conservative in his estimate here, as the consumption of tin-plate on the coast is approximately 200,000 tons per year, and, in addition to this, approximately 100,000 tons per annum is exported to the Orient through Pacific Coast ports; but what we want first on the coast is a blast-furnace plant whereby we can prove that we can manufacture the various grades of pig-iron from our native ores at a cost that will compete with the East and Europe. When this is accomplished, subsidiary companies will soon take up the manufacture of the various products of iron and steel. There already exists on the coast open-hearth and rolling-mill equipment sufficient to take care of the merchant-bar market. What we lack is a mill large enough to roll ship-plates and large shapes and angles, and also rails up to, say, 56-lb. For the latter there is an ever-growing market.

---

[1] Thompson, N., Iron and Steel on the Pacific Coast: Min. & Sci. Press, Vol. 123, pp. 113–114, July 23, 1921.

"Regarding the smelting processes that Mr. Williams mentioned: As I have already stated, a blast-furnace plant is what we want. In my opinion, there is a market on the coast to justify the building of two 400-ton furnaces, one for the production of pig-iron, the other to be used in conjunction with an open-hearth furance in turning out steel billets by the continuous process. An electric furnace could also be considered in conjunction with the latter unit, for the purpose of further refining and, if necessary, making high-grade tool-steel and other high-grade steel castings. The other processes he refers to are more or less visionary.

"One reason perhaps why an iron and steel industry has not been established on the coast has been the scarcity of hematite ore, the iron deposits being largely magnetite. It has been maintained that these ores can not be economically smelted in a blast-furnace without a large percentage of hematite to act as a flux and cheapen the cost of reduction. It is quite true that magnetites carry an extra atom of oxygen and therefore cost more to reduce to metallic iron, but I contend that the higher iron-content of our magnetites, and their low sulphur and phosphorus content, more than compensates for an extra amount of fuel necessary to melt and reduce them. The magnetic ores of the Pacific Coast run from 55 to 68 per cent metallic iron, with sulphur and phosphorus well within the bessemer limit, whereas the hematite ores of the Mesabi Range and Lake Superior rarely run 50 per cent and are as low as 37 per cent metallic iron. In reply to those who maintain that magnetites can not be smelted without at least 25 per cent of hematite, we know that in New York blast-furnaces have been operating for thirty years on 100 per cent magnetite and on ores that are so low-grade and impure that they have to be concentrated by magnetic concentration, which also means crushing and sintering or briquetting before they can be used in the blast-furnace, so if it pays to smelt magnetic ores of this class in the East, surely it will more than pay to smelt our coast ores, which do not require concentration and are practically free from all impurities, including titanium."

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1911	558	$558
1882	2,073	17,766	1912	2,508	2,508
1883	11,191	106,540	1913	2,343	4,485
1884	4,532	40,983	1914	1,436	5,128
1885			1915	724	2,584
1886	3,676	19,250	1916	3,000	6,000
1887			1917	2,874	11,496
1893	250	2,000	1918	3,108	15,947
1894	200	1,500	1919	2,300	13,796
1895			1920	5,975	40,889
1907	400	400	1921	1,970	12,030
1908					
1909	108	174	Totals	59,058	$484,386
1910	579	900			

*Productions for the years 1881-1886 (inc.) were reported as "tons of pig iron," (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analysis of the ores (State Mineralogist's Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

MAGNESITE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV, XVII; Bulletin 38. U. S. G. S., Bulletins 355, 540; Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17 and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2, as calcite has but 44%.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; while the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and Sierra Nevada Mountains, being associated with serpentine areas. The notable exceptions are the sedimentary deposits, at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomitic limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, the experience of the past four years has proven that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine near Preston in Sonoma County, and the White Rock Mine at Pope Valley, Napa County.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proven particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

The desirable qualities of any flooring material (cost not considered) are listed for purposes of analysis or comparison under eighteen heads, as follows: Cleanliness (sanitary qualities), quietness, immunity from abrasion (surface wear), resilience, immunity from slipperiness, appearance, waterproof character, plasticity, warmth (thermal insulation), life (immunity from deterioration with age), acid-proof character, alkali-proof character, fire resistance, elasticity, crushing strength, structural strength (rupture), immunity from expansion and contraction, and lightness. The importance of these several qualities varies with the varying requirements to be met; for instance, in some places, as in hospitals, cleanliness is one of the prime considerations; in other places immunity from abrasion might be one of the principal requisites. As to most of these qualities the conclusion is reached that the magnesia cement affords one of the most satisfactory flooring materials for many purposes, such as in kitchen, laundry, toilet and bathrooms, corridors large rooms or halls in public or other buildings, including hospitals, factories, shops and restaurants.

There is no doubt that the material is steadily coming into more general recognition and favor for these uses. For a few special uses it is more or less disqualified; as an instance, it is not suited for construction of swimming tanks or for conditions of permanent wetness, since under constant immersion it gradually softens, although it is said to withstand intermittent wetting and drying and is recommended for shower baths. Naturally it is not acid-proof and not wholly alkali-proof, which might be a disadvantage in use for laboratory floors and tables; but these are rather special requirements. Its cost per square foot is given (in 1913) as 25 to 33 cents, depending on area, which is estimated to be lower than marble, cork, rubber, clay or mosaic tile, slate or terrazzo. although more expensive than wood, asphalt, linoleum or Portland cement.

In the discussion of the subject (see Bibliography) the causes of failure are ascribed to uncertain climatic changes, lack of uniformity in the mixtures used, lack of care on the part of those handling the materials, possible deterioration of materials used through exposure (either before or after mixing), lack of proper preparation of foundations on which the material is to be laid, and, as a very important factor, experience or nonexperience in the manipulation or actual laying and troweling of the material. Data concerning the percentages of magnesium chloride and of ground calcined magnesia and data concerning the character and quantity of filler and color added to the commercial preparations are naturally guarded as trade secrets by the firms already in the business. The examination and standardization of the raw materials used, and of acceptable filler materials, and the establishment of standard proportions for the mixtures would seem to be about the only satisfactory way of attacking the problem.

The condition of the calcination of magnesite for cement uses is important, as the same material may undoubtedly be greatly varied in its reacting properties by differing treatment in the kiln. It is generally agreed that the magnesite for cement use must be comparatively free from lime, as lime has a greater tendency to reabsorb water and carbon dioxide than the magnesia, thereby causing swelling, and is therefore not so permanent in the completed cement as a pure magnesia material. The fillers used may constitute 10% to 40% of the whole cement, and commonly consist of ground marble, sand, sawdust, cork, asbestos or other materials. As an example of the formulas used in mixing such cements the following are quoted:[1]

Mixtures for the underlying or coarser layer.

[Parts by weight.]

1. 15 parts magnesia.
   10 parts magnesium chloride solution, 20° Baumé.
   10 parts moist sawdust.
   (Sets in 36 hours.)
2. 10 parts magnesia.
   10 parts magnesium chloride solution, 28° Baumé.
   5 parts sawdust.
   (Sets in 16 hours.)
3. 20 parts magnesia.
   15 parts magnesium chloride solution, 20° Baumé.
   4 parts ground cork.
   (Sets in 24 hours.)
4. 5 parts magnesia.
   3 parts magnesium chloride solution, 20° Baumé.
   5 parts ashes.
   (Sets in 24 hours.)

Mixtures for overlying or surface layers.

[Parts by weight.]

1. 40 parts magnesia.
   33 parts magnesium chloride solution, 19° Baumé.
   10 parts asbestos powder.
   5 parts wood flour.
   1 part red ocher.
   (Sets in 24 hours.)
2. 25 parts magnesia.
   25 parts magnesium chloride, 21° Baumé.
   4½ parts wood flour, impregnated with 4½ parts Terpentinharzlösung.
   15 parts yellow ocher.
   (Sets in 30 hours.)

The magnesite used is the fine-ground calcined (not dead-burned) of certain specified kinds or place of derivation regularly sold for the plastic purposes. This material commonly comes in paper-lined casks, barrels or boxes, in which form it is fairly permanent, but it deteriorates by exposure, absorbing carbonic acid and moisture from the air. If carefully handled it can probably be kept unopened a year or more, but it should be used within a few weeks after being opened, even under most favorable conditions.

The use of magnesia cement has been suggested as a protecting coating for mine timbers, particularly against the fire hazard. The necessary qualities for any substance for such purpose have been summarized as follows: It should be resistant to abrasion, and to impact and structural stresses. It should be durable when subjected to the action of the elements, and stable to any minor derangements of the base on which it is placed. It must be relatively unaffected by changes in temperature, by the action of water, and should adhere to the material on which it is placed, and it should also be free from shrinkage cracks due to setting up the material, and have the ability to resist fire. Magnesite cement appears to fulfill the various conditions thus outlined.

---

[1] Scherer, Robert—Der Magnesit, sein Vorkommen, seine Gewinnung und technische Verwertung, pp. 216–217, A. Hartleben's Bibliothek, Wien und Leipzig, 1908.

It is stated that some metallic magnesium has been prepared electrolytically at Niagara Falls from magnesite.

For refractory purposes the calcined magnesite is largely made up into bricks, similar to fire-brick for furnace linings. It is also used un-consolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure, magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magneste. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Imports and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 tons in 1913; 144,747 tons in 1914, and 63,347 tons in 1915; most of it coming from Austria-Hungary and some from Greece. For the same years the production of crude (from 2 to $2\frac{1}{2}$ tons of crude ore required to yield one ton of the calcined) magnesite in California (the sole producer of those years, in the United States) was: 9632 tons, 11,438 tons, 30,721 tons, respectively. For 1916 the California output leaped to 154,052 tons of crude and to 209,648 tons in 1917, but has dropped considerably since then on account of resumption of foreign importations, which totaled 52,483 tons in 1921, valued at $776,384, being admitted duty free. Shipments from Washington were begun late in 1916.

The Fordney Tariff Bill now before Congress places a duty on magnesite, which it is hoped will enable our domestic mines to operate. As passed last July by the House, the schedule placed the duty at $\frac{1}{2}$¢ per pound for crude or ground, and at $\frac{3}{4}$¢ per pound for dead-burned. As reported out of the Senate Finance Committee April 11, 1922, the figures are placed at: Crude magnesite, $\frac{5}{16}$¢ per lb.; caustic, calcined magnesite, $\frac{5}{8}$¢ per lb.; dead-burned and grained magnesite, not suitable for manufacture into oxychloride cements, $\frac{4}{10}$¢ per lb.; magnesite brick, $\frac{4}{10}$¢ per lb., and 10% ad valorem.

Output and Value.

In considering mineral production, the value of the crude material is used as far as practicable. Magnesite presents a peculiar example of a material which previous to 1916 was seldom handled on the market in the crude state. It is mainly calcined and ground before being considered marketable. From 2 to $2\frac{1}{2}$ tons of the crude material are mined to make one ton of the calcined. In the earlier reports an arbitrary value for the crude material at the mine was calculated from the above on the basis of the calcined value, there having been very little product shipped crude. On the contrary, however, considerable tonnages since 1916 have been shipped in the crude state, contracted for at prices ranging from $7 to $17 per ton, f. o. b. rail points. The average was $10.65 per ton, for 1921. This is the basis of the valuation used herein.

The production of crude magnesite in California during the year 1921 totaled 47,837 tons, valued at $511,102 f. o. b. rail-shipping point. This is a considerable decrease from the 83,695 tons and $1,033,491 in 1920.

It looks as if the main hope for the future for California magnesite lies in the development of the plastic business, particularly in the territory west of the Rocky Mountains; and in the manufacture of refractory brick to be utilized mainly by the copper and lead smelters in the same district. It is possible that, after ocean shipping has resumed its normal routes, California magnesite may be sent vià the Panama canal to the Atlantic seaboard; but, on account of our higher production costs, it is difficult to see how we can compete with the Grecian article at Atlantic ports.

Several plants reported making refractory brick here from California magnesite in 1920–1921, at Porterville, Los Angeles and Richmond. The ore from the White Rock Mine in Napa County, and that from the old Kolling (Refractory Magnesite Company) Mine, Sonoma County, is a natural ferro-magnesite and has found a ready market for refractory purposes.

In 1918, for the first time since Tulare County became an important producer of this mineral, it was surpassed in tonnage output for the year, but regained the lead in 1919, followed by Santa Clara and Napa counties, respectively. The same ranking was retained in 1920; but Santa Clara took the lead in 1921. The largest individual producer in 1920–1921 was the Western Magnesite Development Co., in Santa Clara County, operated under lease by C. S. Maltby. A total of 20,187 tons were reported as shipped calcined, representing approximately 45,421 tons of crude ore.

Production of crude magnesite for 1921, by counties, is given in the following table, with total crude value:

County	Tons	Value
Fresno	954	$9,540
Santa Clara	25,800	280,000
Stanislaus	3,378	33,158
Tulare	11,454	125,594
Napa, San Benito, Sonoma*	6,251	62,810
Totals	47,837	$511,102

*Combined to conceal output of a single operator in each.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that, first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

---

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

Annual production of magnesite for California, amount and value, since 1887, is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1906	4,032	$40,320
1888	600	9,000	1907	6,405	57,720
1889	600	9,000	1908	10,582	80,822
1890	600	9,000	1909	7,942	62,588
1891	1,500	15,000	1910	16,570	113,887
1892	1,500	15,000	1911	8,858	67,430
1893	1,093	10,930	1912	10,512	105,120
1894	1,440	10,240	1913	9,632	77,056
1895	2,200	17,000	1914	11,438	114,380
1896	1,500	11,000	1915	30,721	283,461
1897	1,143	13,671	1916	154,052	1,311,893
1898	1,263	19,075	1917	209,648	1,976,227
1899	1,280	18,480	1918	83,974	803,492
1900	2,252	19,333	1919	44,696	452,094
1901	4,726	43,057	1920	83,695	1,033,491
1902	2,830	20,655	1921	47,837	511,102
1903	1,361	20,515			
1904	2,850	9,298	Totals	773,865	$7,386,558
1905	3,933	16,221			

PYRITES.

Bibliography: Bulletin 38. Min. & Sci. Press, Vol. 114, pp. 825, 840.

Pyrites are mined for use in the manufacture of sulphuric acid, which in turn is used in large quantities in the preparation of explosives and of fertilizers. Two properties in Alameda and one each in Shasta and Mariposa counties reported a total production in 1921 of 110,025 tons, valued at $473,735, which is a decrease from 1920. The material shipped carried 42% to 46% S.

This does not include the large quantities of pyrite, chalcopyrite and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates for their precious-metal values. California has available supplies of sulphide ores suitable for the manufacture of sulphuric acid far in excess of the local requirements; but the excess acid if made here is not of sufficient value per ton to pay the freight rates to eastern markets. One of our large copper smelters here could, alone, flood the market with sulphuric acid from its copper ores roasted.

The total recorded pyrite production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1911	54,225	$182,954
1899	5,400	28,620	1912	69,872	203,470
1900	3,642	21,133	1913	79,000	218,537
1901	4,578	18,429	1914	79,267	230,058
1902	17,525	60,306	1915	92,462	293,148
1903	24,311	94,000	1916	120,525	372,969
1904	15,043	62,992	1917	111,325	323,704
1905	15,503	63,958	1918	128,329	425,012
1906	46,689	145,895	1919	147,024	540,300
1907	82,270	251,774	1920	146,001	530,581
1908	107,081	610,335	1921	110,025	473,735
1909	457,867	1,389,802			
1910	42,621	179,862	Totals	1,966,585	$6,751,624

MUSEUM.

Each issue of the Monthly Chapter will contain a brief account of current museum activities. This will include a list of new acquisitions received, with names of donors, a report of the number of vistiors registered, and other items tending to keep the public advised of the advantages, from an educational standpoint, afforded by the exceptionally fine collection of rocks and minerals of both economic and academic value comprising the 16,000 specimens on exhibition. The museum contains not only one or more samples of most of the known minerals found in California, but hundreds of specimens from other states and foreign countries as well. An account of the arrangement and classification of specimens in this collection will be given in an early issue of 'Mining in California.'

Aside from its purely educational features, the museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

Among specimens received recently, and catalogued for the museum, are the following:

19581. *Scorodite* (hydrous ferric arsenate with Arsenopyrite). Two pieces—one showing crystals; one amorphous or massive. From Western Utah Copper Co., Salt Lake City, Utah, by R. T. Walker, Salt Lake City.

19582, 19583, 19584. *Bauxite* and *Bauxitic Clay*. From Riverside County, Cal., by L. M. Richard, Venice, Cal.

19585. *Cassiterite* (tin oxide, 'Wood Tin'), showing variety of colors. From Ropp Mine, Northern Nigeria, British West Africa, by W. E. Thorne, London, England.

19586. *Cassiterite* (tin oxide; crystals and massive crystalline pieces). From Ropp Mine, Northern Nigeria, British West Africa, by W. E. Thorne, London, England.

19587. *Topaz* (aluminum fluo-silicate; associated with cassiterite in tin placers). From Ropp Mine, Northern Nigeria, British West Africa, by W. E. Thorne, London, England.

19588. *Tschermigite* (hydrous ammonium-aluminum sulphate, 'ammonia alum'). From Royce Mine, Sweetwater Co., Wyoming. Purchased.

19589. *Hematite* (iron oxide; suitable for paint pigment). From Riverside County, Cal., by W. H. Cone, San Francisco.

19590 to 19595. *Pyrite*, *Chalcocite*, Kaolinized *Shale*, *Cuprite*, *Dacite*, *Quartz Porphyry*. From Nevada, by D. A. Hall, San Francisco.

19596. *Breccia* (recemented and silicified; contains bornite, oxidized). From Engels-Walter district, Plumas County, by D. A. Hall, San Francisco.

19597. *Turgite* (hydrous iron oxide, 'hydro-hematite'). Distinguished from hematite and limonite by its exploding when heating a/c water. From Inyo County, Cal., by Rocky Mtn. George, Shoshone, Cal.

19598. *Chalcedony* and *Quartz* (silicon dioxide, cryptocrystalline and crystalline, respectively). From near Healdsburg, Sonoma County, Cal., by C. A. Perry, Healdsburg.

19599. Amphibole *Asbestos* (variety of crocidolite; complex Na-Fe silicate). From South America, by Gilbert Rayburn, Long Beach, Cal.

19600. *Iceland Spar* (variety of calcite). From near Wabuska, Nev., by Fred Eckley, San Francisco.

19601. *Realgar* (arsenic monosulphide). From near Geyserville, Sonoma County, Cal., by John King, Healdsburg.

19602. *Graphite* (flat crystals disseminated in calcite). From Indian Reservation, Imperial Valley, Cal., by Geo. M. Nelson, San Francisco.

19603. *Chalcedony* (cryptocrystalline silica, banded; in part polished). By Mrs. E. Stahl, Berkeley, Cal.

19604. *Alunogen* (hydrous aluminum sulphate). From Inyo County, Cal., by S. F. Paul, Oakland, Cal.

19605. *Garnet* (Grossularite variety, in Eclogite schist). From near Healdsburg, Sonoma County, Cal., by C. A. Perry, Healdsburg.

19606, 19607. *Dacite* (quartz andesite). Pyroxene *Andesite* ('basaltoid'). From Java, by Dr. F. Boscha, Clarens, Switzerland.

During the month a total of 463 visitors signed their names on the museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

Frank Sanborn, Petrologist.

A total of 269 samples were received and determined during the thirty days covered by this report. A sample of massive crocidolite (a complex silicate) from Napa County, and one of bauxite from Riverside County, were two of the few that were interesting in a mineralogical way. The latter came from a deposit that may prove to be of commercial value.

Bauxite is a hydrated oxide of aluminum and is valuable as an aluminum ore and for the manufacture of refractory brick. The general appearance of the mineral is unattractive and would in all probability remain unnoticed by the average prospector. The color varies from white to yellow, brown to red, and occurs in earthy masses resembling clay; also in concretionary forms.

The following very simple test for determining bauxite was devised by Mr. J. M. Hill of the U. S. Geological Survey: If a fragment of bauxite is firmly rubbed on a piece of glass, a thin coating of the mineral will adhere to the smooth surface, and if high grade, it is very difficult to remove by rubbing with the fingers. The coating left by a high alumina clay can be rubbed off without great effort. The more bauxitic the material, the greater the adhering properties—until it is almost impossible to rub off a pure bauxite film with the fingers.

A list of the minerals of possible value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed upon request, if the reference number is given.

05–105	Arsenopyrite, and some scorodite.
05–106	Clay, does not burn white.
05–107	Sodium sulphate.
05–108	Limonite (yellow ocher).
05–109	Clay, alumina content low.
05–110	Fluorspar.
05–111	Fluorite (fluorspar).
05–112	Copper ore, some gold and silver present.
05–113	Thenardite.
05–114	Calcium sulphate.
05–115	Coal, non-coking.
05–116	Chrysotile asbestos, long fibre.
05–117	Alunogen.

05–118	Calcium sulphate, some silica and impurities.
05–119	Dumortierite, associated with lime carbonate.
05–120	Diatomaceous earth.
05–121	Realgar.
05–122	Arsenopyrite, some gold present.
05–123	Pumice.
05–124	Magnesite, good grade.
05–125	Chalcedony.
05–126	Soapstone; also diatomaceous earth.
05–127	Gold quartz.
05–128	Magnetite.
05–129	Copper ore, some gold and silver present.
05–130	Oxides and sulphides of iron (paint pigment).
05–131	Soapstone.
05–132	Mica, biotite variety.
05–133	Molybdenite.
05–134	Amorphous silica.
05–135	Mica; also amphibole asbestos.
05–136	Soda nitre.
05–137	Molybdenite and molybdite in quartz.
05–138	Petzite, free gold associated.
05–139	Limestone.
05–140	Feldspar (orthoclase).

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey Professional Paper 129-C, Graphic and Mechanical Computation of Thickness of Strata and Distance to a Stratum. By J. B. Mertie, Jr.

U. S. Geological Survey Professional Paper 129-E, The Byram Calcareous Marl of Mississippi and Its Foraminifera. By Wythe Cooke and Joseph A. Cushman.

U. S. Geological Survey Mineral Resources; Stone in 1920, by G. F. Loughlin and A. T. Coons.

U. S. Geological Survey Mineral Resources; Cement in 1920, by Ernest F. Burchard.

U. S. Bureau of Mines Reports of Investigations:

Serial No. 2318—The Unsaturated Hydrocarbon Constituents of Gas from Destructive Distillation of a Water-Gas Tar and Coal Mixture. By Ralph L. Brown (Associate Organic Chemist, U. S. B. M.).

Serial No. 2319—Prevention of Illness Among Miners. By R. R. Sayers, Chief Surgeon, U. S. B. M., and P. A. Surgeon, U. S. Public Health Service.

Serial No. 2320—Performance of Fan-Pipe Installations in Metal Mines. By D. Harrington (Supervising Mining Engineer, U. S. B. M.) and George M. Hunt (in charge, Section of Wood Conservation, U. S. Forest Products Laboratory, Madison, Wis.).

Serial No. 2322—Properties of Typical Crude Oils from Producing Fields of Kansas. By E. W. Dean, M. B. Cooke and A. D. Bauer.

Serial No. 2324—Some Factors Affecting Products from Destructive Distillation of Oil Shales. By Lewis C. Karrick (Associate Oil-Shale Technologist, U. S. B. M.).

OFFICIAL PUBLICATIONS RECEIVED, *Governmental*—Continued.

Serial No. 2325. Fighting a Mine Fire with Its Own Gases. By C. A. Allen (Mining Engineer, U. S. B. M., and Chief Mine Inspector for the Industrial Commission of Utah) and A. C. Watts (Chief Engineer and Geologist for the Utah Fuel Co.).

Serial No. 2326—Platinum.

Serial No. 2327—Soapstone. By Raymond B. Ladoo (Mineral Technoligist. B. of M.).

Serial No. 2329—Use of Low-Pressure Gas Burners in Oil-Field Boilers. By M. P. Yonker (Ref. Engineer, B. of M.).

Serial No. 2330—Recent Articles on Petroleum and Allied Substances. Compiled by E. H. Burroughs (Bibliographer, U. S. B. M.).

U. S. Bureau of Standards Technological Papers:

No. 203—Influence of Phosphorus Upon the Micro-Structure and Hardness of Low-Carbon, Open-Hearth Steels. By Edward C. Groesbeck (Associate Chemist, Bureau of Standards).

No. 204—Cutting Fluids. By Eugene C. Bingham (Chemist, B. of S.).

No. 205—Tensile Properties of Some Structural Alloy Steels at High Temperatures. By H. J. French (Physicist, B. of S.).

U. S. Bureau of Standards Scientific Papers:

No. 426—Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel and Aluminum. By Wilmer H. Souder (Physicist) and Peter Hidnert (Assistant Physicist).

No. 427—Some Effects of the Distributed Capacity Between Inductance Coils and the Ground. By Gregory Breit (Consulting Physicist).

Commission of Bureau of Mines, Arkansas; Minerals of Arkansas. By Jim G. Ferguson.

Surveyor General, State of California; Rules and Regulations Concerning Oil and Gas Permits and Leases.

Surveyor General, State of California; Laws Governing the Sale of School Lands in the State of California.

Twenty-third Annual Report of Mining Industry of Idaho, 1921.

Kentucky Geological Survey; The Coal Industry of Kentucky. By Willard Rouse Jillson.

Michigan Geological and Biological Survey; Bulletin No. 30, Geological Series 25, Inland Lakes of Michigan. By I. D. Scott.

Department of Conservation and Development, New Jersey; Annual Report, 1921.

Tennessee Geological Survey; Bulletin No. 25, Administrative Report of the State Geologist, Nashville, Tenn., 1920.

Bulletin No. 26, Mineral Resources of the Waynesboro Quadrangle, Tenn. By Hugh D. Miser.

Boletin del Petroleo, Mexico.

Boletin Minero, Organ del Departmento de Minas, Mexico, Tomo XII, Numero 6, December, 1921.

Records of the Geological Survey of Victoria, Vol. IV, Pt. III. Department of Mines, Victoria, Australia.

Department of Mines, Queensland Geological Survey. Pub. No. 289, Small Gasteropoda from the Lower Cretaceous of Queensland, by R. Etheredge, Jr.

Catalog of the Fossil Bryoza (Polyzoa) in the Department of Geology, British Museum. Vol. III. By W. D. Lang, ScD., F.G.S.

Societies and Eucational Institutions.

American Mining Congress Journal. April, 1922.

American Mineralogist. December, 1921.

Mining and Metallurgical Society of America. Bulletin No. 153.

Mining and Metallurgy. January, February and March, 1922.

Journal of Geology. February and March, 1922.

Proceedings of the Engineers Society of Western Pennsylvania. July and October numbers, 1921.

Philippine Journal of Science. November, 1921.

Bulletin of the Canadian Institute of Mining and Metallurgy. April, 1922.

Proceedings and Transactions of the Nova Scotian Institute of Science, Vol. XV, Part I. Session of 1918–1919.

OFFICIAL PUBLICATIONS RECEIVED,
Societies and Educational Institutions—Continued.

Transactions of the Institution of Mining and Metallurgy. Vol. XXIX.
Journal and Proceedings of the Royal Society of New South Wales for 1920. Vol. LIV.
Proceedings of the Royal Society of Queensland for 1919. Vols. XXXI–XXXII.
Archivos de la Asociascion Peruana Progreso de la Ciencia. Ano. 1921. Lima, Peru.

Books.

American Mining Manual, 1922.
Placer Mining, Surface Arrangements, Ore, Mining, Assaying. International Library of Technology.
Patents. Graham and Harris.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco
The Record, Associated Oil Company, San Francisco.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Which a Market Is Sought.

02–65 Asbestos deposit; both chrysotile and amphibole.
02–66 Gravel mine; old Table Mountain Channel.
02–67 Cinnabar deposit in Kings County.
02–68 Fuller's earth.
02–69 Drift gravel mines in Nevada and Sierra counties.
02–70 Nitrate deposits in Inyo County; or financial aid in developing.
02–71 Hydraulic property; twenty-one claims, Trinity County.
02–72 Dredging ground, Siskiyou County.
02–73 Limestone, manganese and magnesite.
02–74 Chrysotile asbestos deposit; San Luis Obispo County.
02–75 Mining equipment; Inyo County (2-stamp mill, 40 h. p. and 6 h. p. gas engines, windmill, and one mile of pipe).

Mineral Products or Deposits Wanted.

03–50 Pyrite (for export).
03–51 Zinc ores; carbonate, oxide or silicate, or old dumps containing above.
03–52 Lepidolite and colemanite.
03–53 Gold placers which do not conflict with debris law.
03–54 Diatomaceous earth; tonnage.
03–55 Volcanic ash; fine-grained, in Southern California; tonnage.
03–56 Placer gravel deposit.
03–57 Alunogen; or other aluminum sulphate mineral; deposit or tonnage.
03–59 Mica; deposit or tonnage.
03–60 Cadmium; five to six tons per month.
03–61 Peacock copper ore (bornite).
03–62 Quarry owners; who may be interested in the manufacture of a new composition wall board made from waste rock by a cheap chemical process.

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01– 9 Anything connected with chemistry, mineralogy, or assaying. Student, single. Age 18. References.

01–10 Anything in chemical laboratory or assay office. Student, single. Age 21. References.

01–11 Assayer. Ten years mining experience. Student under U. S. Veterans Bureau. Married. Age 32.

01–12 Miner, timberman, assayer, surveyor, or mine bookkeeper. Technical graduate. Speaks Spanish. Some experience. Single. Age 25.

01–13 Assayer-Chemist. Ten years experience, smelter assaying. Married. Age 36. References.

MAY, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

Shasta County.

T. P. Peterson of Heroult has located twenty claims on an extensive outcrop of iron gossan, on the south side of Pit river opposite Heroult. The deposit is being developed for mineral paint. Different colors of material have been obtained from the gossan outcrop.

Harvey Sallee of Old Diggins, has taken a lease on the *Mammoth* and *Texas Consolidated* group of mines, and a force of men are employed in cleaning out the lower tunnels on both of these properties. The Mammoth tunnel is 2000 feet in length, and the Texas Consolidated tunnel is about 1600 feet in length. The ore shoots on both of these levels were cut off by faults, and the present development work will be confined to picking up these ore shoots.

The *Mount Shasta Silica Company* of Weed, will start excavating work on their deposit of diatomaceous earth, which is situated in the northeastern part of the county. J. W. West, of Weed, is president of the company.

A high grade shoot of ore has been developed at the *Summit Mine* in the French Gulch District. Two hundred tons of ore have been broken and the Brunswick mill has been put into shape to mill this ore. The property is under lease to Charles Fox and associates of French Gulch.

Siskiyou County.

Hydraulic mining is active near Cecilville, Oak Bar, Forks of the Salmon River, Sawyer's Bar, Scott's Bar, and Fort Jones. At Cecilville, the *Jefferson Consolidated, Consetti* and other properties are under operation

It is reported that the *Humbug Mining Company* has uncovered some very encouraging prospects at their mine on Humbug Creek. One nugget taken out weighed over half an ounce.

Trinity County.

Placer mining is active at more than a score of properties in the county, and the placer gold output this year promises to be large.

The deep snow of the past winter has provided ample water and most of the companies are either operating to capacity or are preparing to do so.

Three hydraulic giants are in operation at the *Lorenz Hydraulic Mine,* near Weaverville.

It is reported that hydraulic operations will soon be resumed on the *Union Hill Placer Mine,* near Douglas City. The flumes and ditches will be repaired in a short time.

The *American-Italian Mining Company* are operating two giants on the Paulson ranch near Lewiston.

The *Shasta Dredging Company* has taken over its option on the Van Matre ranch near Minersville.

The *Layman Mine,* four miles southwest of Hayfork, which is under lease and bond to George Bland of Redding is under operation. There is a five-stamp mill on the property. Seven men are employed.

It is reported that an important strike has been made in the *Old Venicia Mine,* in Eastman Gulch, five miles up the Trinity River from Lewiston. A nine-inch vein of quartz, carrying rich sulphide ore was cut in a new tunnel which has been driven a distance of 212 feet. This tunnel is 150 feet below the old workings. The mine has a record of production of $500,000, from the upper levels.

The mine is owned by the Paulson Bros. of Lewiston, who have bonded the property to J. E. Bennett of San Jose. Four men are employed.

The *Golden Jubilee Mine,* which is situated on Coffee Creek, northwest of Carville, has been bonded to the *Coffee Creek Mining Company.* C. J. Kerr is general manager.

The *Strode Mine,* situated north of Carrville, has been under active development for the past two years by the *Strode Mining Company* of Milwaukee, Wisconsin, J. S. Maxwell, president; John Hillips, secretary. A new tunnel has been driven 1200 feet, 210 feet below No. 6 tunnel level, and No. 1 ore shoot has been opened up on this level for a distance of 300 feet. The vein is from 4 to 12 feet wide, and is said to carry high values in gold. The company proposes to continue development work on this level until No. 2 ore shoot is intersected. With the development of these two shoots of ore, the company proposes to start their mill. James F. Meikel is superintendent.

The *Enterprise Mine,* in East Fork Mining District, 8 miles north of North Fork, has been recently bonded by W. R. Biglow, of Weaverville. A considerable tonnage of ore has been developed and ore is being trammed to mill bins. The mill is expected to be placed under operation sometime this month. Twelve men are employed.

The *Bonanza Group* of mines, which are situated on the East Branch of the East Fork, about 11 miles north of North Fork, are being developed by J. L. Johnston of North Fork.

AUBURN FIELD DIVISION.

C. A. Logan, Mining Engineer.

El Dorado County.

This county has been the scene of quartz mining since 1850, but although a multitude of companies have operated there, and much gold has been produced, few workings have been put down to sufficient depth to conclusively prove the mines. El Dorado County has been and still remains a favorite hunting ground for the small promoter. Two reasons are chiefly responsible for this. The romantic early history and the easily won wealth of the old placer diggings have been powerful magnets. The neglected state of the quartz mines during the past twenty years has tended to depreciate the price of mining properties to the point where many prospects of real merit can be had on very liberal terms. Many such have as a result been bought cheaply and have been made the basis for stock pormotions, but the promoters have usually lacked the funds and the capacity as miners to do justice to their properties. The cumulative result of such work has been to further bring the region into disrepute among those who are financially able to do the right kind of mining. The production of gold in later years has fallen very low and at present will probably not exceed $20,000 annually.

Distribution and character of the mines.

The quartz mines occur in a number of rather distinct belts each with its own peculiar characteristics. The east belt mines lie in the granodiorite and mica schist east of the Mother Lode, and are typified by usually narrower and richer veins, and richer and more complex sulphides than the main lode. The Mother Lode traverses the county for about thirty miles and shows here as far as developed the same characteristics as in the counties to the south; namely, wider veins, heavier gouges, generally lenticular quartz bodies, low and medium grade ores and simple ores carrying free gold with little silver, the sulphides being almost entirely iron pyrites, and the treatment of the ore being simple, the chief aim desired being cheapness because of the usual good size but lower grade of the ore bodies, as distinguished from the narrower and richer veins in the schists and granite. Diabase flanks the Mariposa slates of the Mother Lode on the west for over 20 miles, but most of the mining done on this lode has been within the black slates. North of Garden Valley a wedge of amphibolite splits the slate into two belts. Mines have been worked here both in the slate and in the amphibolite.

West of the Mother Lode in the southern part of the county gold has been mined in the metamorphic and igneous rocks. One type here is the replacement deposit, in which the gold occurs mostly in the pyrite, which is disseminated rather evenly through the replacement area; there are also quartz mines here, and these have usually shown ores more capricious in grade and less regular in their distribution than on the main lode. Some disseminated sulphide ore bodies have also been exploited east of the main lode.

In the extreme western part of the county, south of Auburn in Placer County, and in granodiorite and amphibolite, lie numerous but slightly prospected quartz veins. They are narrow and medium in width, are usually accompanied by dikes like so many of the east belt veins, and show medium and high grade ores which carry a high silver content and good grade sulphides, principally galena and pyrite.

Brief notice of a few of the deeper mines of the county will serve to strengthen the opinion that there must be numerous properties left in the county that well merit development. There is not at present any active mine operating at any important depth in the county. It is peculiarly a region for the operator who is willing to begin operation without waiting for the other fellow to first open a big mine nearby. Most of the mines and prospects have been idle so long and their present owners know so little about them that they are unable to furnish the information necessary to interest engineers and attract adequate capital.

The deepest mines worked in the county are: Union, 1640 feet; Mount Pleasant, 1065 feet; Taylor, 1200 feet; Pacific, 2000 feet; Zantgraf, 1100 feet; Nashville, 1200 feet, and Church, 1400 feet. Leaving out the Taylor, for which figures are not fully at hand, six of these have produced about twelve and a half million dollars, and the Pacific is possibly the only one of the list whose deeper levels may be said to have been at all prospected.

Argonaut Mine is near Greenwood on the Mother Lode. Its history for the past year and a half illustrates the working of the system called the unit plan. The limited mine workings show the wide quartz vein and the stringer lead vein of the lode. Numerous open cuts and shallow shafts were opened in the big quartz vein and the rock that was milled years ago was nearly all from this vein, which is here as elsewhere of pockety nature but of general low grade. The old mill had burned 30 years ago or more and the claims had lain idle for a long time when they were bought very cheap in May, 1921. A Gibson mill was put up in July and the sale of 'units' was begun. About 60 tons of rock was gathered from different parts of the claims and crushed. About the end of October work was stopped, and has not been resumed since.

Big Canyon Mine is five miles south of Diamond Springs. The ore was formed by the mineralization of a mass of diabase breccia, which was silicified and impregnated with auriferous pyrite, the pyrite forming about 3% of the ore. It was a wide and cheaply mined ore body and is said to have been stoped for a depth of 500 feet, length of 400 feet and a thickness of 20 to 30 feet. The last work was in 1914. The ore was narrower and more broken on the 700 level than above.

The *Fairview* prospect near Garden Valley is being promoted on the unit plan by F. C. Fox, who did a little work along the same lines last year at the Argonaut property.

Hercules Mining Company is doing some work at the *Buzzard Mine,* which is about eleven miles from Auburn and three miles from the Zantgraf Mine. A body of complex ore, carrying copper, zinc, gold, silver and possibly other metals, has been partly opened by a shaft 250 feet deep and some short drifts. From time to time small quantities of ore have been crushed in a five-stamp mill but the property has never been adequately financed so progress has been slow. It is thought the ore will necessitate a different plan of treatment. At last report a contract had been let to deepen the shaft.

Work has been resumed on the *Hines Gilbert* property near Spanish Dry Diggings and some encouraging reports have been sent out by the promoters.

The *Mount Pleasant* is on the east belt near Grizzly Flat and the three veins lie at and near the contact of the granodiorite and micaceous schists. A shaft has been sunk 1065 feet and levels driven every 100 feet, with between nine thousand and ten thousand feet of drifts. Several ore shoots from 100 to 800 feet long and in places 7 or 8 feet thick have been stoped between the 700 level and the surface. About 75,000 tons milled have yielded $1,046,748 according to a report by W. B. Tucker.

The *Standard Unit* near Garden Valley is being prospected by an adit. From time to time rich float has been picked up on the surface there, but no vein in place of corresponding value has been found yet. The operators hope to find this vein in the adit.

The *Taylor Mine* was the best producer in the northern part of the county. It is on the westward section of the Mother Lode near Garden Valley. It has an amphibolite schist footwall and a slate hanging wall. The mine was discovered about 1865 and was a producer until 1902. On the surface the vein was small, increasing to six feet wide at 100 feet depth, and in the lower levels was milled 20 to 30 feet wide, keeping 40 stamps and later more in operation. The shaft reached an inclined depth of 1200 feet with levels every 100 feet. The ore shoot is said to have been about 500 feet long. The later operators attempted to make a big tonnage record and handled much low grade ore in consequence. Certain geological conditions, to be more fully covered in the Mother Lode report, also intervened below 600 feet. There is said to have been 4 to 5 feet of very good ore on the hanging wall, which would have paid handsomely alone.

Union Mine is on the Mother Lode three miles south of El Dorado. It was worked from 1851 to 1876 and again from 1902 to 1909. A vertical depth of 1640 feet was reached in the Springfield shaft. Several ore shoots from 150 to 250 feet long and up to 15 feet thick, but averaging about 4 feet were stoped to a maximum depth of 1300 feet. The veins lie in slate walls and show general characteristics of the mines in the slate further south on the lode. The ore is reported to have averaged $6 a ton in later years but that taken out near the surface in the early days ran around $30 a ton. The owners have held this mine many years with the intention of reopening it when costs recede sufficiently.

The *Zantgraf* was the representative mine on the west granodiorite-amphibolite area, and the only one yet opened there to any depth worth mentioning. The vein on this property does not outcrop conspicuously, and the land had been patented as railroad land for many years before it was discovered to be mineral by Jake Zantgraf, who found some promising float and in tracing it found the vein. The main shoot was of good length and was stoped from near the surface to an inclined depth of 1100 feet. The ore was of only average grade, taken as a whole, but varied greatly in value, some areas being very good and others low grade. Like many mines that would make good under proper treatment, it was burdened with a plant too large for it and excessive overhead expenses. There are a number of veins running nearly parallel to the Zantgraf in the same district that have never been more than scratched.

Placer County.

Blue Eyes Prospect. Gold Dollar Mining Co. The new prospect adit on this property has reached a length of about 1200 feet, little work having been done during the winter. The channel has not yet been struck in this adit. A contract has just been let for 500 feet additional work in the adit.

Copper Bottom Mine is in the Iowa Hill district. In July, 1921, H. Melbourne Saggan bought the property and took options on several hundred acres adjoining, including the old Succor Flat Mine and the Golden Star, a prospect which is thought to cover the upstream extension of the channel. These combined properties give a length of about a mile on the probable course of the Succor Flat channel, in ground that has so far been worked only to the line of the Succor Flat Mine, just west of the Copper Bottom.

Up to the time of his death in May, 1922, Saggan had done considerable work here. A 30 h.p. steam boiler, air compressor, drills, hoist and pumps were put in. A few days before his death he reported that he had mined some 300 tons of gravel from a bench or remnant of an upper run, which lies about 50 feet vertically above the main channel. This upper gravel was worked 100 feet wide for a length of 30 feet and depth of six feet, and was low grade, although Saggan claimed it could be worked at a small profit as it is free wash. The lower channel is reached on the Copper Bottom through an adit 400 feet long and a slope of 300 feet, giving a vertical lift of 120 feet for the water, which at last report was making about 300 gallons per minute. He reopened these old workings and claimed he had in the bottom gravel that would run $9 to $10 a yard, but had not run any new drifts or crosscuts so had no idea of the width of the channel here.

The Succor Flat Mine, though itself supposed to be pretty well worked out is of possible value with the Copper Bottom as the old Succor Flat workings might be reopened sufficiently to give drainage to the new ground after a short connecting drift is run.

Georgia Hill Mining Company operating near Yankee Jims have continued their upper drift some 500 feet since the 1921 report but have not yet reported finding any pay gravel.

William Davis of Auburn expects to take a crew of eight men to the *Home Ticket* property near Last Chance before the first of June to resume work on the incline that is being put down from the bottom of the old workings in search of a deeper channel. If this lower channel is found to carry gravel of payable grade, it will probably mean new life for Last Chance as the channel is virgin for some distance.

Lyman Gilmore has done considerable exploratory work the past year in search of channel gravel on claims near Iowa Hill, but to date has not reported finding any continuous channel.

SAN FRANCISCO FIELD DIVISION.

E. S. Boalich, Chief Mining Engineer.

San Benito County.

The last full report on San Benito County was published by the Bureau in 1916, and is contained in Report XV of the State Mineralogist. Most of the other counties have been covered within the past two, or at most, three years. Even though conditions in general were known to be quiet in this portion of the state, it was deemed proper to visit San Benito, when opportunity offered during April of the present year, so that up-to-date information might be at hand, and that corrections in the 1916 report might be made a matter of record.

The following material is presented as a result of several days of field work where no investigations were pursued further, if inquiry revealed the fact that properties were idle and remained in the same hands as they were when Report XV was written. Changes in ownership, additional development, and new activities are particularly noted, and, under the heading of each mineral, reference is made to publications already in circulation which give details relative to the subject being discussed.

Acknowledgments.

The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines and mineral deposits throughout the county, and particularly the personal assistance in the field rendered by Mr. Hugo Fischl, of Hollister.

Geography and Geology.

The geography and more particularly the geology of this county have been discussed at length in the following State Mineralogist's Reports: XI, p. 370; XII, p. 493; XV, p. 616; and in State Mining Bureau Bulletin No. 89, p. 69.

Briefly summarized, it may be stated that San Benito County lies in the heart of the middle Coast Range Mountains, occupying an area about twenty-four miles wide and sixty-six miles long. The eastern border includes a portion of the Diablo Range; the center includes the San Benito, Tres Pinos and several smaller mountain valleys; and the western portion is occupied by the Gavilan Range.

The Gavilan is composed of crystalline schists, limestone and granitic rocks of Paleozoic age, all known as the Santa Lucia Series.

Franciscan formations are found in the northern portion of the Diablo Range within the county, and in the New Idria region in the southeastern corner.

Sedimentary rocks occur in the area between Hollister and the Lomas Muertas; in the main central valleys; and in the Diablo Range south of Panoche Valley, as well as in the southwestern portion of the county.

Mineral Resources.

For many years San Benito has led all other counties in the state in regard to production of quicksilver. It does not rank very high as far as other mineral output is concerned, although its resources include deposits of antimony, asbestos, barite, bituminous rock, chromite, clay, coal, dolomite, gypsum, gems, limestone, magnesite, mineral water, miscellaneous stone, and other mineral substances.

Lack of transportation facilities has retarded development in this region. Many of the streams have not been bridged, and in periods of high water, even teams are often unable to negotiate the river crossings for days at a time.

The only railroads in the county are the branch line of the Southern Pacific from Gilroy to Tres Pinos, via Hollister, and the 'California Central' which runs from Chittenden to the cement plant at San Juan.

Distributing points for the southern portion of the county are Mendota and Coalinga (Fresno County), and Kings City (Monterey County).

MINERAL PRODUCTION TABLE.

Year	Quicksilver		Lime and limestone	Gypsum		Mineral water		Stone	Dolomite		Other minerals
	Flasks	Value	Value	Tons	Value	Gallons	Value	Value	Tons	Value	Value
[1]Total including 1915	296,899	$14,551,450	$189,528	58,712	$238,795	128,720	$25,415	$1,111,619	------	------	[2]$163,232
1916	11,110	1,032,156	------	------	------	------	------	155,250	8,100	$25,515	[3]526
1917	11,150	1,057,770	------	------	------	------	------	101,148	7,000	15,000	[4]59,245
1918	10,715	1,234,027	------	------	------	------	------	103,295	5,000	20,625	[5]179,516
1919	7,409	668,989	------	------	------	------	------	134,300	7,000	24,500	[6]418,687
1920	3,887	296,942	------	------	------	------	------	207,250	18,000	57,750	[7]921,082
Totals	341,170	$18,841,334	$189,528	58,712	$238,795	128,720	$25,415	$1,842,862	45,100	$143,390	$1,742,288
Grand total value											$23,023,612

[1] For details in previous years see Report XV State Mineralogist, p. 620.
[2] Includes antimony, asphalt, coal, gems, and clay.
[3] Includes antimony and mineral water.
[4] Includes antimony, chromite, magnesite, and mineral water.
[5] Includes cement, manganese, mineral water, chromite, and magnesite.
[6] Includes cement, magnesite, and mineral water.
[7] Includes cement, magnesite, and mineral water.

ANTIMONY.

References: State Mineralogist's Reports VIII, p. 485; X, p. 516; XV, p. 622.

There has been absolutely no activity in the antimony mines lying in the northeast corner of the county, during recent years. Conditions are approximately as described in Report XV except for the fact that the Florence Group and the Rip Van Winkle mines have been abandoned entirely, title to the French Group has reverted to Mr. T. H. French of Hollister, and the Quien Sabe Mine is now owned by the De Laveaga Estate, Hollister. Most of the deposits lie on Antimony Mountain, the bulk of which is included in T. 11 S., R. 7 E., M. D. M.

ASBESTOS.

On the southwest slope of Sampson Peak and extending down Clear Creek toward Hernandez, in the eastern portion of T. 18 S., R. 11 E., there is a broad belt of serpentine which contains chrysotile asbestos to a greater or less extent. As mentioned in Report XVIII of the State Mineralogist, p. 46, the California Asbestos Mining Co. is actively developing four claims in that region and is erecting a mill for the separation of the fibre before making shipments. Mr. Norris K. Davis, 400 7th Street, San Francisco, is the principal owner of the property, and the mill mentioned is being constructed according to original ideas of his own, patent for which has been applied for.

The ore so far developed is low grade and the company does not contemplate the production of the higher grades of spinning fibre.

Some desultory prospecting for asbestos is going on at two or three other points near Clear Creek, but nothing particularly encouraging was noted.

ASPHALT.

References: U. S. Geol. Survey Annual Report XXII, Part I, p. 409; State Mineralogist's Report XV, p. 624.

As shown in above references, asphalt has been commercially produced in a small way from a deposit about ten miles northeast of Metz. Occurrences have also been reported along the contact of the sedimentary rocks with the Santa Lucia Series on the east flank of the Gavilan range, southwest of Hollister, but as far as is known no investigations have ever been carried on which would tend to show their extent or importance.

H. V. Underwood, Hollister, Cal., has recently leased a portion of the Rancho El Gabilan owned by John S. Bryan, also of Hollister, and is planning to develop an outcropping of asphaltum which was found about two miles southwest of the Old Mission Portland Cement Company's quarries, southeast of the town of San Juan.

BARITE.

Reference: State Mineralogist's Report XV, p. 624.

The only known occurrence of barite in the county is on the ranch of Bardin Bros., Salinas, Cal., which includes a portion of Gavilan (or Fremont) Peak. It is said that this deposit was first discovered in the early '60's, but the only work done was between 1915 and 1919. Idle at the present time.

BITUMINOUS ROCK.

References: U. S. Geol. Survey Annual Report XXII, Part I, p. 409; State Mineralogist's Report XV, p. 626.

Part of deposit mentioned above under asphalt, lying ten miles northeast of Metz. Of little apparent economic importance. Idle and undeveloped. John Matthews, King City, Cal., owner.

CEMENT.

Reference: State Mineralogist's Report XV, p. 626.

Large deposits of limestone suitable for the manufacture of cement are known in this county.

There is one cement plant, that of the Old Mission Portland Cement Company, J. A. McCarthy, president, at San Juan Bautista. The company's offices are in the Mills Building, San Francisco.

In Report XV there will be found a detailed description of the property owned and controlled by this company, and of the plant, which was only partially completed in 1916 when that publication was being prepared.

Cement production began here in 1918 and has been continuous ever since.

This is one of the two plants, only, in California using the wet process, the other being that of the Southwestern Portland Cement Company, at Victorville, San Bernardino County.

CHROMITE.

References: State Mineralogist's Reports IV, p. 136; VI, pt. I, p. 100; VIII, pp. 483, 490; XV, p. 630. State Mining Bureau Bull. 27, p. 126; Bull. 38, pp. 269, 362; Bull. 67, p. 81; Bulletin 76, p. 166. U. S. Geol. Survey Bull. 603, p. 208.

In the serpentine area in the vicinity of New Idria, chromite occurs abundantly as small float. No large bodies have ever been discovered and even under the stimulus of war time demand the production was very small. This branch of the mineral industry is dormant in San Benito County as is the case elsewhere throughout the state By reference to the above publications, the reader may obtain complete details relative to work previously done, owners of deposits, etc.

CLAY.

References: State Mineralogist's Report XV, p. 630. State Mining Bureau Bull. 38, p. 226.

The deposit of plastic clay mentioned in above report as occurring on the San Justo Ranch, three miles south of Hollister, is now owned by Dr. J. M. O'Donnell, of Hollister. It has never been commercially developed.

Clay which would make good brick is abundant in many of the valleys of the county. It is reported that the Alpine Quicksilver Mining Company burned 260,000 brick on lower Clear Creek, near Hernandez, in 1915. Some of them remain where they were made and from a cursory inspection are still first class in every respect.

In this connection it is interesting to note the deposit of montmorillonite, or 'mineral soap,' which lies along San Benito River about eighteen miles south of Tres Pinos, on the San Benito Road. According to local authority, a considerable quantity of this material was hauled to the railroad and shipped to San Francisco in the late '80's.

COAL.

References: State Mineralogist's Reports IV, p. 14; V, p. 104; VI, p. 117; VIII, p. 483; XI, p. 372; XII, p. 61; XIII, p. 54; XV, p. 630; XVIII, p. 145. U. S. Geol. Survey Bull. 431–6; Bull. 585, p. 29; Bull. 603, p. 209. U. S. Bur. Mines Bull. 22, pp. 53, 396.

Indications of coal have been noted at a great many points in the sedimentary rocks of the county. The only deposits that have been developed to any extent are the Mascovich Mine (formerly known as the Trafton), near the head of James Creek, N.W. $\frac{1}{4}$, Sec. 21, T. 17 S., R. 10 E., and the property of the San Benito Coal Mining Company near the Ashurst Ranch, on Larious Creek in the New Idria District.

The former, owned by N. P. Mascovich, Gilroy, Cal., is described fully in Report XV of the State Mineralogist, and has been idle since that publication was issued, and details regarding the latter mine were given in the April number of Mining in California (Chap. of Rept. XVIII, p. 145). The companies' offices are in the Bank of Italy Building, Oakland, Cal. Operations were under way during recent months, but had been temporarily suspended when the district was visited in April, 1922.

In the opinion of the writer, coal in this county is an item of considerable potential importance, but at the present moment the possibility of profitably exploiting deposits of this fuel here does not appear to be very encouraging.

The producer faces high haulage costs from the mine to the railroad, in addition to other obstacles which are common to practically all California operators, some of whom are much more favorably situated.

Without attempting to analyze the conditions which exist in the southern part of San Benito County, it would appear that there should be some advantage to be gained by cooperation between the coal interests and the operators of the quicksilver and magnesite mines that are located in the same vicinity.

COPPER.

References: State Mineralogist's Reports VIII, p. 489; XI, p. 371; XV, p. 631. Bull. 23, p. 146; Bull. 50, p. 172.

Traces of copper are to be seen near the Vancouver Pinnacles, in Sec. 33, T. 16 S., R. 7 E., and on Lewis Creek, in Secs. 2, 3, and 4, T. 19 S., R. 10 E. There is nothing new to report in this connection since this field was investigated by the Bureau in 1916. The small amount of development work which was done at both of these localities, years ago, gave negative results.

DIATOMACEOUS EARTH.

Reference: State Mineralogist's Report XV, p. 636.

The above reference contains the only mention of this material in the county as far as has been ascertained. Occurrences are reported on the N. D. Page ranch near San Benito, and on the Leonard Estate, Sec. 28, T. 17 S., R. 8 E. Neither have been prospected to date.

DOLOMITE.

Reference: State Mineralogist's Report XV, p. 633.

Dolomite, associated with the limestones of the Gavilan Range, exists in large quantities in the hills southwest of Hollister. The facts relative to this subject, as given in the above reference, cover the situation today quite completely. Consistent production has been made annually from the deposits of the San Benito Quarries Company, on the O'Hara Ranch; the San Benito Vineyards Company; and the E. L. Martin Ranch. Work done on the Leopold Palmtag property resulted in the opening up of high grade limestone, rather than dolomite.

GEMS.

References: State Mineralogist's Report XV, p. 636. Bull. 67, p. 157. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149, 331. U. S. Geol. Survey Bull. 603, p. 208; Mineral Resources 1909, Pt. II, p. 742. Am. Jour. Sci. Vol. 27, p. 398. Science, 1908, p. 616.

In Sec. 25, T. 18 S., R. 12 E., about 9 miles southeast of New Idria, there is a deposit of a gem mineral called benitoite, which, to date, has never been discovered elsewhere. It is a titano-silicate of barium.

R. W. Dallas of Coalinga opened up this deposit shortly after its discovery in 1907 and placed some of the gems on the market. For several years no output has been recorded, however. In 1920 a company called the San Benito Gem Co., with headquarters in Hollister, acquired the property, but it still remains inactive.

The publications cited at the beginning of this paragraph will give complete details regarding this entire subject to any one interested in going into the matter further.

GOLD.

References: State Mineralogist's Reports VIII, p. 490; XII, p. 227; XIII, p. 318; XV, p. 637.

The extent of the county's mineralization is emphasized by recording the fact that gold has been found at several places in sufficient quantity to encourage the expenditure of considerable money in carrying on prospecting operations. As far as could be learned, all such attempts have been long since abandoned, and hope of commercially producing gold has died.

The principal showings of the yellow metal were on the northeast flank of North Chalone Peak, in about Sec. 14, T. 17 S., R. 7 E.; about three miles south of those prospects, and on the Flint Estate in San Juan Canyon, west of Hollister.

GYPSUM.

References: State Mineralogist's Reports VIII, p. 490; XIII, p. 504; XV, p. 638. Bull. 38, p. 287.

At this time there is no gypsum being produced in the county, but several deposits have been developed and are capable of considerable output. There is little of interest to note in addition to the material contained in the 1916 report. The quarries mentioned in that publication, in Secs. 8 and 17, T. 18 S., R. 9 E., are now owned by the Lyons Gypsum Co., T. W. G. Lyons, president, King City, Cal., and are no longer in the hands of J. F. Dunne of Hollister.

IRON.

References: State Mineralogist's Reports VIII, p. 490; XV, p. 639; XVIII, p. 111. Bull. 38, p. 299.

Surface indications of iron, none of which have been investigated, have been reported between Stayton and the Panoche Pass, in the Diablo Range; in T. 17 S., R. 12 E.; and in T. 15 S., R. 6 E.

LIMESTONE.

References: State Mineralogist's Reports VIII, p. 488; XII, p. 393; XIII, p. 629; XV, p. 640.

The above references, particularly the last one which was written in 1916, contain complete information regarding the limestone resources of this county. The principal recent activity in the development of limestone deposits has been by the Old Mission Portland Cement Co., San Juan, Cal. Many of the deposits, though long known, have been inactive for years.

There is now being developed limestone on the ranch of Leopold Palmtag, about ten miles southwest of Hollister. This property has been bonded to the Pacific Coast Steel Co., which organization is sinking test pits and thoroughly prospecting the ground. It is understood that if sufficient tonnage is developed the Southern Pacific Railroad Co. will put in a spur track to the property—right of way over the route to be traversed being already held by the railroad.

MAGNESITE.

References: State Mineralogist's Report XV, p. 643. U. S. Geol. Survey Bull. 355, p. 38; Bull. 540, p. 503; Bull. 603, p. 208; Min. Res. 1911, Pt. II, p. 1120.

On the west slope of Sampson Peak, in T. 17 S., R. 11 E., there is a massive deposit of magnesite practically all of which is owned by the following companies: Sampson Magnesite Co., Ralph H. Moore, president, 547 New Call Building, San Francisco. This company's property and operations have been described in detail in the above-mentioned references. Since the last report of the State Mineralogist considerable production has been reported, a calcining plant has been constructed at the property and many improvements as regards buildings, road construction, etc., have been carried on. There now exists a good auto road to Mendota, Fresno County, which is the most convenient railroad connection. Haulage costs by truck to that point are said to be about $6.50 per ton.

San Benito Magnesite Company (Standard Group), Hugo Fischl, Hollister, and Mrs. Alexander Morrison, San Francisco, owners.

Adjoining the Sampson property on the southwest lies the Standard Group of eleven claims which have been developed by a number of surface workings and which give evidence of containing a very large quantity of high grade magnesite. Equipment here consists of camp buildings, blacksmith shop, tool house, etc. Only two carloads of ore have been actually shipped to date. From this ore there was manufactured a refractory brick which is said to have exceeded the standard requirements of that product now on the market.

MANGANESE.

References: State Mineralogist's Reports XII, p. 330; XV, p. 644. Bull. 76, p. 59.

There is nothing new to report regarding manganese in this county. This branch of the mineral industry is dormant almost everywhere, and the deposits in this particular section were never proved to be of commercial value or extent. The showings which have been noted in the past all lie in T. 13 S., R. 8 E., near the Merced County line.

MINERAL WATER.

References: State Mineralogist's Reports XIII, p. 516; XV, p. 645. U. S. Geol. Survey W. S. Paper 338, p. 306.

Since 1890 there has been a small annual output of mineral water from a well four miles southeast of Hollister which is said to have medicinal effects. The San Benito Mineral Spring Company artifically carbonates the water, most of which is sold locally.

PETROLEUM AND NATURAL GAS.

References: State Mineralogist's Reports VIII, p. 488; XI, p. 372; VII, p. 356; XV, p. 646. State Min. Bur. Bull. 19, p. 148; Bull. 89, p. 69. U. S. Geol. Survey Bull. 431; Bull. 581-d; Bull. 603; Monograph 13.

Seepages of oil and gas have been long known to exist in many localities in the county. Exploration or drilling operations have been carried on in the Santa Ana Valley; Topo Valley; San Benito Valley; between New Idria and Little Panoche Creek; near Twomey Creek; west of Silver Creek; in the Vallecitos, and elsewhere, but to date no commercial production has resulted.

The geology and oil possibilities of San Benito County are discussed at length by Vander Leck in Bull. 89, pages 69 to 82 (issued July, 1921), and the reader interested in going into this question should consult that bulletin as well as the many other references cited above.

QUICKSILVER.

References: State Mineralogist's Reports VIII, p. 483; X, p. 515; XI, p. 373; XII, p. 365; XIII, p. 599; XV, p. 647. State Mining Bureau Bull. 27; Bull. 78, p. 93. U. S. Geol. Survey Monograph XIII.

For the last twenty years San Benito County has been the leading quicksilver producing center, not only in California, but in the United States.

Here is located the New Idria Mine, which has a record of continuous operation and total output second only to the famous New Almaden property in Santa Clara County.

No attempt will be made here to give comprehensive data on the occurrence and production of quicksilver, first, because the industry is now dormant, and second, because the subject has been covered in the fullest possible detail, particularly in Bull. 78, 'Quicksilver Resources of California,' by Walter W. Bradley, published in 1918.

Bradley describes the geology and ore occurrences in various portions of the county, lists all the mines, and records their development, equipment, and possibilities; and touches on the metallurgical practice in every instance. His report also contains maps of the quicksilver districts and bibliography of literature referring to each mine as well as to the general subject under discussion.

STONE INDUSTRY.

Reference: State Mineralogist's Report XV, p. 671.

No new development in the stone industry was noted in addition to the gravel pits near Hollister and the granite quarry at Logan, described in Report XV, above cited.

The latter quarry, operated by the Granite Rock Company, A. R. Wilson, manager, Watsonville, Cal., is of great size and has produced hundreds of thousands of tons of crushed rock annually for several years past.

The rock is a basic granite and is ideal for railroad ballast and highway construction.

Conclusion.

San Benito County is typical of many portions of California as regards its relation to the mineral industry of the state.

It would probably be overlooked by the average mining man if he were making up a list of the 'mining counties' of California—and the casual visitor might note only the hay, fruit, and cattle industries as being of importance.

However, minerals worth a million and a half dollars were produced here last year—at a period of general depression—and as the Pacific Coast becomes more thickly populated and demand for raw materials grows, a survey of the situation gives ample proof of the ability of this section to increase its mineral yield indefinitely, and in many directions.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Kern County.

Mojave Mining District: Considerable interest has been directed to this district, due to the discovery by *Wagman and McFarland* about the middle of April, 1922, of a gold vein lying to the west of the holdings of the Standard Gold Mining Company. The outcrop is reported to be 100 feet long, and the vein averages 5 to 8 feet in width, carrying good gold values for the entire width. Some very high grade ore also has been found by Wagman and McFarland on their new locations.

Randsburg District: *Fox and Barret*, who have leases numbers 2, 3, 4 and 5 of the *Foster Group* are now sinking to develop this territory in depth. This work will be watched with much interest, for if ore is encountered in this ground, it will result in a great deal more development in this particular section of the camp.

The *Minnehaha*, which adjoins the Yellow Aster Mine, is reported to have made a rich strike on the 200 foot level. A sample taken over a width of one foot is said to have assayed $300 gold to the ton, the ore being almost entirely of a free milling nature.

The property is owned by Judge E. Maginnis, and is said to have produced $100,000 to date.

The *Mizpah-Tonopah*, lying to the northwest of the California Rand Silver, is reported to have encountered good values on its claims.

Standard Gold Mining Company. This company, last year, took over the holdings of the old Exposed Treasure Mine. For the last few months, it has been recyaniding old tailings in a leaching plant. A new slimes plant of 125 tons capacity has just been completed, and this will be put in operation very soon on the accumulated slimes from former operations.

The company also proposes to unwater the mines and commence vigorous development work. W. H. Tharpe is manager of the property.

Los Angeles County.

The *California Graphite Leasing Company* is operating the graphite property of the California Graphite Company, situated in the San Francisquito Canyon, 18 miles north from Saugus.

The leasing company has been running its flotation mill, which has a capacity of 1000 lbs. of finished product per hour. The plant was erected in 1920, but has operated only intermittently up to the present time.

In view of the duty which the proposed new tariff will give the graphite industry, this company should be able to meet foreign competition from Ceylon, Madagascar, and Canada, and the higher graphite content of its ores should allow it to more than hold its own with the graphite producers of Alabama, New York and Pennsylvania.

The duty proposed in the new tariff is as follows:

> "Graphite or plumbago, crude or refined; Amorphous, 10 per cent ad valorem; crystalline, crystalline lump, shipped or dust, 20 per cent ad valorem; crystalline flake 2 cents per lb. The term crystalline flake as used by the Senate Committee is specified to mean graphite or plumbago which occurs disseminated as a relatively thin plate throughout its containing rock, decomposed or not, and which may be or has been separated therefrom by ordinary crushing, pulverizing, screening, or mechanical concentration process, such flake being made up of a number of parallel laminae, which may be separated by mechanical means."

California Rock Products Company is running its plant continuously. It is on the San Fernando Road, a few miles from Los Angeles. This company is crushing green, red, yellow and white colored igneous rock to supply the artificial-roof companies in Los Angeles with roofing material, and is developing a business of considerable importance.

Riverside County.

The *Brooklyn* gold claim has been bonded by Mr. J. Holmes for $40,000. This is located four miles north of the Iron Chief Mine in the

Eagle Mountains. At present Mr. Holmes is sinking a well for the development of water near his claim, prior to commencing development work.

The *Good Hope Mine,* situated 4½ miles southwest of Perris, has come into the possession of Sellio Trujillo, whose grandfather discovered the mine more than fifty years ago. Mr. Trujillo proposes to unwater the mine, and develop the ore bodies in same. The property originally had a five-stamp mill, and later a twenty-stamp mill with Frue concentraters was built and operated by a Massachusetts company. Owing to internal dissension within the company and outside litigation the company finally suspended operations and the mine was allowed to fill with water.

The average value of the ore is reported to have been $10 gold per ton, being mainly free milling.

The mine is referred to in the following reports of the State Mineralogist: VIII, page 527; IX, page 151; XI, page 106; XII, page 221; XIII, page 311.

San Bernardino County.

The *American Trona Company* resumed the manufacture of potash and borax about April 15, having had its plants at Trona closed down since June, 1921. The company expects to produce 50 tons of potash and 30 tons of borax daily, and will undoubtedly be benefited by the duty imposed by the new proposed tariff bill before Congress.

The tariff bill, as reported by the Senate Committee, places a duty on potash for a period of five years, after which it is placed on the free list. The section of the bill referring to potash is as follows:

> "Potassium chloride or muriate of potash, potassium sulphate, kainite, wood ashes, and all crude potash salts not specially provided for:
>
> "*Provided*, that for a period of five years, beginning on the day following the passage of this act, there shall be levied, collected, and paid on the actual potash (potassium oxide) content of all the foregoing, a duty of two and one-half cents per pound the first two years, two cents per pound the third year, one and one-half cents per pound the fourth year, and one cent per pound the fifth year;
>
> "*Provided, further*, that thereafter the said potash content shall be free of duty."

With this tariff protection and the further advantage that the company can also produce borax, thus distributing its overhead charges, the company undoubtedly will be in a position to meet all competition from other sources.

Randsburg District: There is nothing so convincing as actual results obtained at a mining property, and the following may be of particular value to those interested in Randsburg.

Besides the regular dividend (No. 28) of two cents, the *California Rand Silver* directors declared the fourth extra 10 cents for 1922, the two dividends representing a distribution of $153,600. Since January 1st of this year, a total of 50 cents per share, or $640,000, and since organization it has paid a grand total in dividends of $1.33½ per share, or $1,708,800.

EXTRACTION AND PROGRESS.

For the month of April General Manager C. S. Meroney reports the following figures:

Ore shipped to smelter	999 tons
Ore to mill	2182 tons
Ore to mill dump	89 tons
Waste	3831 tons
Total extraction	7101 tons

Advancement in the workings of the mine was as follows:

Drifts	673 feet
Crosscuts	437 feet
Raises	146 feet
Twelfth level station	41 feet
Number two shaft	9 feet
Number four shaft	90 feet
Number six shaft	40 feet
Total progress	1436 feet

Of the twenty-eight cars shipped during the month, the smelter has made returns on 22 cars, giving a total revenue for April of $132,947.69. The six cars to be reported on, including one car of concentrates, represent production of better than average value. Pay roll for the month was $28,839.78.

Of the 2832 tons milled in April, assays gave $16.45 per ton, recovery per ton $14.49. The total value of the concentrates from this ore was $34,276.98, an average of $460.26 per ton.

The *Riggs Mine,* 1¼ miles from Riggs Station, on the Tonopah and Tidewater Railway, and 12 miles north of Silver Lake, is to be reopened and developed along modern lines of mining. The property was originally developed by the late Col. Frank Riggs, and had a production record of several hundred thousand dollars of high grade silver ore.

The officers of the new company are as follows: E. S. Freeze, president, Mrs. M. M. Riggs, vice president, and Philip Chandler, secretary.

San Diego County.

The *Vitrified Products Company* has been formed to work a clay deposit, situated about 14 miles from San Diego. It proposes to erect a plant at the property for the manufacture of brick and tile and later enlarge this to produce vitrified brick, tile, and other clay products.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

From April 8, 1922, to and including May 6, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well	Field
FRESNO COUNTY:					
Premier Oil Company	24	20	14	17	Coalinga
KERN COUNTY:					
Bear State Oil Company	30	28	21	10	Belridge
Associated Oil Company	26	30	24	2	Elk Hills
Pacific Oil Company	31	30	24	9	Elk Hills
Pacific Oil Company	27	30	24	21	Elk Hills
Pacific Oil Company	35	30	24	51	Elk Hills
Pacific Oil Company	35	30	24	9	Elk Hills
Pan American Petroleum Company	2	31	24	1-G	Elk Hills
Pan American Petroleum Company	2	31	24	6-F	Elk Hills
Pan American Petroleum Company	2	31	24	7-F	Elk Hills
Pan American Petroleum Company	2	31	24	8-F	Elk Hills
Union Oil Company	26	30	24	9	Elk Hills
Bangor Oil Company	19	28	28	2	Kern River
Union Oil Company	11	28	27	5	Kern River
Associated Oil Company	34	31	23	56	Midway
Boston Pacific Oil Company	32	31	24	5-B	Midway
Caribou Oil Mining Company	28	31	23	5	Midway
Consolidated Mutual Oil Company	28	31	23	16	Midway
Engineers Oil Company	14	31	22	10	Midway
Honolulu Consolidated Oil Company	12	32	24	1	Midway
Midway Pacific Oil Company	24	31	22	9	Midway
Pacific Oil Company	7	32	24	38	Midway
Pacific Oil Company	7	32	24	36	Midway
Pacific Oil Company	35	31	23	5	Midway
Pacific Oil Company	9	32	24	11	Midway
Louis Titus	28	31	23	3	Midway
Union Oil Company	34	31	23	13	Midway
Union Oil Company	34	31	23	12	Midway
R. B. & O. Oil Company	28	12	24	25	Sunset
O. J. Berry	34	12	24	9	Sunset
C. J. Berry	34	12	24	20	Sunset
Pacific Midway Company	32	12	23	4	Sunset
Republic Petroleum Company	6	11	23	9	Sunset
Tannehill Oil Company	33	12	24	14	Sunset
P. Welch	18	11	23	1-G	Sunset
Elkern Oil Company	20	29	23	1	----------------
LOS ANGELES COUNTY:					
Black Bear Petroleum Syndicate	29	4	12	1	Long Beach
Drexel Clarkston	25	4	13	1	Long Beach
Dabney Syndicate	30	4	12	9	Long Beach
Geo. F. Getty	20	4	12	1	Long Beach
Henderson Petroleum Syndicate	29	4	12	1	Long Beach
A. T. Jergins Trust	19	4	12	1	Long Beach
A. T. Jergins Syndicate	29	4	12	2	Long Beach
Leonard Jones	29	4	12	2	Long Beach
W. M. Keck	29	4	12	1	Long Beach
Pan Pacific Consolidated Oil Co.	20	4	12	1	Long Beach
Petroleum Midway Company, Ltd.	19	4	12	1	Long Beach
Shell Company	29	4	12	1	Long Beach
Shell Company	29	4	12	Dobyns 1	Long Beach
Shell Company	19	4	12	1	Long Beach
Shell Company	29	4	12	Bixby 1	Long Beach
Shell Company	29	4	12	3	Long Beach
Shell Company	29	4	12	4-A	Long Beach
Shell Company	29	4	12	2	Long Beach
Union Oil Company	29	4	12	2	Long Beach
Union Oil Company	30	4	12	3	Long Beach
United Oil Company	29	4	12	4	Long Beach
Rancho La Brea Oil Company	16	1	15	53	Salt Lake
Amalgamated Oil Company	31	2	11	4	Santa Fe Springs
General Petroleum Corporation	6	3	11	86	Santa Fe Springs
General Petroleum Corporation	6	3	11	79	Santa Fe Springs
General Petroleum Corporation	5	3	11	6	Santa Fe Springs
Standard Oil Company	31	2	11	2	Santa Fe Springs
Central Oil Company	23	2	11	73	Whittier
F. F. Hoard	25	1	13	1	----------------
C. C. Mangenheimer	25	2	15	1	----------------
Santa Monica Pet. and Dev. Co.	28	1	19	1	----------------
Sunland Oil Company, Inc.	2	2	14	1	----------------

Company	Sec.	Twp.	Range	Well	Field
ORANGE COUNTY:					
Brea Canon Oil Company	2	3	10	35	Brea Olinda
Standard Oil Company	18	3	10	92	Coyote Hills
Eddystone Oil Corporation	34	5	11	1	Huntington Beach
Globe Petroleum Corporation	34	5	11	1	Huntington Beach
Invader Oil Company	2	6	11	1	Huntington Beach
J. P. Oil Company	11	6	11	2	Huntington Beach
Malis-Anchor Oil Company	2	6	11	2	Huntington Beach
Petroleum Midway Company, Ltd.	2	6	11	2	Huntington Beach
Petroleum Midway Company, Ltd.	2	6	11	2-A	Huntington Beach
Shell Company	2	6	11	1	Huntington Beach
Standard Oil Company	34	5	11	12	Huntington Beach
Standard Oil Company	34	5	11	11	Huntington Beach
Standard Oil Company	2	6	11	7-A	Huntington Beach
Sun Oil Company of California	2	6	11	6	Huntington Beach
United States Oil Corporation	2	6	11	1	Huntington Beach
U. S. Petroleum Syndicate	27	6	10	1	Newport
Amalgamated Oil Company	28	3	9	2	Richfield
Standard Oil Company	29	3	9	15-A	Richfield
Henry R. Dabney	14	5	12	1	
SACRAMENTO COUNTY:					
Associated Development Company	25	6	7	1	
VENTURA COUNTY:					
Calumet Oil Company	3	3	19	13	Bradsdale
Oak Ridge Oil Company	1	3	19	2	Bradsdale
Camarillo Refining and Pet. Co.	34	2	20	3	Conejo
Cooper Petroleum Company	33	2	20	43	Conejo
Equity Petroleum Company	4	1	20	1	Conejo
Equity Petroleum Company	4	1	20	2	Conejo
Equity Petroleum Company	4	1	20	3	Conejo
Equity Petroleum Company	4	1	20	4	Conejo
Equity Petroleum Company	4	1	20	5	Conejo
Equity Petroleum Company	4	1	20	6	Conejo
Equity Petroleum Company	4	1	20	7	Conejo
Equity Petroleum Company	4	1	20	8	Conejo
Equity Petroleum Company	4	1	20	9	Conejo
Equity Petroleum Company	4	1	20	10	Conejo
A. J. Singer	28	2	20	2	Conejo
Santa Fe Petroleum Company	17	4	18	6	Piru
Oak Ridge Oil Company	21	3	21	2	Santa Paula
Wilson Petroleum Company	33	3	2	1	Santa Paula
A. H. MacFarland	10	2	19	1	Simi
Santa Paula Oil Company	18	3	20	7	South Mountain
McKee-Bramham-Lonn	33	4	23	1	

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

PROGRESS REPORT ON PLACER GOLD INVESTIGATION.

By CHAS. S. HALEY.

The district covered this month embraces some of the most important and valuable placer deposits in California. A preliminary survey is being made of the whole district embraced by the drainage of the Yuba, the Bear, the American, and the Mokelumne, Cosumnes and Calaveras rivers; with the intention of completing the work in detail as soon as the weather conditions permit work in the high Sierras.

In the Nevada City and Grass Valley districts, much has been learned regarding small or 'pup' channels since Lindgren's report, and much new drift ground has been and is being developed. At North Bloomfield, in the Malakoff diggings, the presence of a new and deeper channel to the west has been evidenced by drifting operations recently, with the discovery of gravel which runs twenty-five dollars a yard and over. On the authority of the manager of the property of the River Mines, who control about seven miles of this channel, it is stated that prospecting operations have evidenced about eight hundred million yards of gravel still available for hydraulicking, with an average value of over twelve cents a yard.

In the Greenhorn and Bear River country, recent development work, notably at the Quaker Hill Mine, has shown several hundred million yards of fifteen cent gravel.

The estimates of gravel ultimately available on the drainage of the rivers above mentioned will evidently have to be revised, and greatly revised, in an upward direction. From my own investigations so far, it seems fairly safe to assume a total of about seven billion yards of gravel, distributed among the different drainage areas as follows, approximately: Feather River, 500,000,000 yards; Yuba River, 3,500,000,000 yards; Bear and American rivers, 2,500,000,000 yards; Mokelumne, Cosumnes, Calaveras and Stanislaus rivers, 500,000,000 yards. The above figures include both drift and hydraulic ground.

The above total of seven billion yards, judging from past performance in the days of unrestricted mining, should yield from twelve to fifteen cents a yard; and if hydraulic mining is restored under proper restrictions with regard to control of debris, there is roughly a billion dollars to be recovered from these drainage systems alone.

The importance of glacial action with regard to distribution of gravels and pay has been greatly underestimated; and present theories seem capable of considerable revision in this regard. It is not necessary, as many geologists seem to have thought, to postulate a pre-Tertiary glacial period to admit the possibility of glacial action on these channels. The Tertiary period extended over several hundred thousand years; and during that time, previous to and during the extensive vulcanism, there must have been many climatic changes caused by shifting of ocean currents and pressure areas, which would have given the Sierras a climate similar to that prevailing at present in Alaska and British Columbia, entirely independent of any general shifting of the polar ice-cap. The evidence and positive proof of local glaciation in these channels is so pronounced that it can not be overlooked. Discrepancies in bedrock elevations in the downstream course of the channels may be in part, although not altogether, explained by the differences in datum from which these elevations were obtained; but the presence of bedrock fluting; of single and double U-shaped channels; of heaps of heavy boulders of varied character which could not have been carried far from their source by water alone; of the immense white quartz channels in which all the metamorphic wall rock has been ground up and transported out by water—the grinding would have been impractical without the aid of ice action; and the fact that the depth and width of these channels so often increase as one follows upstream; all of these phenomena indicate the deposition of much of this material and the hollowing out of the channels by local glaciation.

That water sorting followed, and was intermittent with, this action, is also indubitable; as the shingling and sorting of the gravel shows beyond doubt that these were the courses of ancient streams.

One thing which may well be noticed; and a point on which the writer intends to make investigations, is the relative elevations of the lava-gravel contacts. It may well be possible that a series of readings taken on these will show the original grades of these streams far better than bedrock elevations will, even when properly correlated. At any rate, it is worth trying out.

The economic value of these gold placers to the state as a whole; and the inestimable benefit which will accrue to the farming industry of the state by a proper conservation of the water for their working, and its release during the dry season, are more than ever evident to any unprejudiced investigation. This without in any way interfering with the existing rights of the power and irrigation companies; and eventually working to their positive advantage. The additional benefit of clearing the river channels in the valley to their old grades and restoring navigation up to Marysville and Colusa for all time, without the need of maintaining expensive levees, will also function to the benefit of the agricultural interests in giving them permanent protection from floods and low transportation rates for their produce. Thirty millions spent by the United States in building restraining dams according to the original provisions of the Caminetti act will be repaid to the farmers and miners of the state fifty times over in the course of the next century; and the flood problems caused by present conditions from natural erosion of denuded soil will be solved for all time.

MEMORANDA ON ASPHALT AND BITUMINOUS SAND DEPOSITS OF CALIFORNIA.

By Lawrence Vander Leck.

The bituminous shales and sands in California are found in strata of Tertiary Age. The principal deposits are either in, or in close association with the Miocene diatomaceous shale, commonly known as Monterey shale. These bituminous shales and sands differ from those of the Rocky Mountain Region in that the organic matter contained in them has been distilled and is present in either the form of liquid petroleum or asphaltum, whereas the Rocky Mountain deposits have to undergo the process of destructive distillation of the organic matter before petroleum or asphaltum is formed. As a matter of fact the California deposits are nothing more than sands and porous lenses of shale, which are more or less saturated with liquid petroleum. These sands and shales, by reason of structural movements have been uplifted into the zone of erosion with the result that most of the lighter constituents have evaporated, or run off, leaving behind a tarry residuum.

The simple process of distillation will separate the petroleum from the particles of sand and shale. In the Santa Maria District the return by distillation is about 20 gallons of crude oil per ton of sand or shale. The only distillation plant now in operation is located near Casmalia Station, Santa Barbara County, and is operated by David E. Day, formerly of the U. S. Bureau of Mines. The following is a list of the principal deposits:

Point Arena District.

About two and one-half miles north of the town of Point Arena, Mendocino County, on the O'Neill Ranch, are two outcrops of bituminous sand interbedded in the Monterey shale. These sands are from four to six feet in width and can be followed for one and one-half miles along the strike. A second deposit occurs about 500 feet north and east of the Point Arena lighthouse. The asphaltum here is found directly in the Monterey shale.

Marin County.

Seams of asphalt are found in the Monterey shale along the cliffs about two miles north of the town of Bolinas. This deposit is not very extensive.

Santa Cruz District.

Beginning at the town of Santa Cruz, deposits of asphalt occur along the coast for a distance of about six miles north. These deposits are very extensive and have in recent years been used as quarries for paving stone.

Santa Clara County.

About two miles west of the town of Sargent, in what is known as the Sargent Oil Field, are large deposits of bituminous shale outcropping along the contact of the Monterey shale and the serpentine. These deposits are about 15 acres in extent.

Salinas Valley District.

About ten miles northeast of King City and two miles west of the town of Loanoke, in Secs. 14 and 15, T. 19 S., R. 9 E., M. D. B. and M., occur deposits of bituminous shale along the contact of the Santa Marguerita formation and the granite. These deposits were known as the Mylar Quarry. On the west side of the Salinas Valley, about ten miles southeast of the town of Bradley, is what is known as the Pleyto District, an outcropping of bituminous sand at the contact of the Paso Robles formation and the Salinas shale.

San Luis Obispo District.

The principal deposits in this district occur between the town of Pismo and the town of Edna, on the north portion of what is known as the Arroyo Grande Oil Fields. This is probably the largest deposit of bituminous sand in California. It occurs in the Pismo formation, the total area covered by this deposit being, approximately, two square miles. At one time, there was an asphalt mine located about one mile south of the town of Edna. This, however, has been dismantled.

Santa Maria District. (Santa Barbara County.)

About four miles south and west of the town of Guadalupe, on the Pezzoni Ranch, there are numerous outcrops of bituminous shale. These deposits cover about twenty acres in extent. In Schumann Canyon, about one mile north of Casmalia Station, the Monterey shale is heavily bituminized and it is at this location that Dr. Day has his distillation plant. Deposits in this locality cover about 600 acres. In the old Santa Maria Field, along Graciosa Ridge, there are outcrops of bituminous sands along the contact of the Monterey and the Fernando formation. On the Rancho San Carlos Jonata, just south of Red Rock Mountain, there are numerous outcrops of bituminous sand in the Monterey shale. About six miles west of Zaca Lake and about two miles east of the town of Sisquoc, on what is known as Asphaltum Creek, there are large deposits of bituminous sand and shale occurring at the contact of the Fernando and the Monterey shale.

Coast Region from Gaviota Pass to Santa Barbara.

Along the shore between these two points the Monterey shale is present and is dipping at a high angle to the west. At various points there are outcrops of bituminous sand in the shale.

Ojai Valley District.

In the Ojai Valley, about four miles east of Nordhoff, on the property of the Pan American Petroleum Company, are numerous deposits of asphaltum.

Sunset District.

Along the southwest edge of the Sunset Oil Fields, in Kern County, at the contact of the McKittrick formation and the Maricopa shale, are numerous deposits of bituminous sand and shale. These deposits are found in the following sections, 14 and 13, T. 11 N., R. 24 W., and in sections 18, 19 and 20, T. 11 N., R. 23 W., S. B. B. and M.

McKittrick District.

One mile south and west of the town of McKittrick, in Secs. 19 and 20, 21, 28 and 29, R. 22 E., T. 30 S., M. D. B. and M., at the contact of the McKittrick formation and the Maricopa shale, there are very large deposits of bituminous shale and asphaltum. In the Gould Hills, about ten miles north of the town of McKittrick, in Sec. 7, T. 29 S., R. 21 E., is an outcrop of bituminous shale in the Santa Marguerita formation.

Santa Monica District.

Along the ocean front about one mile north of Santa Monica Canyon, there are small deposits of asphaltum in the diatomaceous shale.

Los Angeles County.

There are a few dry sand outcrops in the Brea Canyon. In Los Angeles County asphalt deposits occur at the La Brea Pit, in the Salt Lake Oilfield near Sherman. These pits are on the Hancock Ranch, and are being excavated by the Smithsonian Institute or the Carnegie Foundation, for fossils. There are also some outcrops of tar sands in the northwestern residence district of Los Angeles.

References: U. S. Geol. Survey 22d Annual Report; 'Asphalt and Bituminous Rock Deposits in the United States,' G. H. Eldridge, pp.379–452. U. S. Geol. Survey Santa Cruz Folio, No. 163. U. S. Geol. Survey San Luis Obispo Folio, No. 101.

NON-METALLIC MINERALS OF SOUTHERN CALIFORNIA.

By M. A. Newman.

GYPSUM.

In 1895, the reported production of gypsum from 13 producing states was 265,503 tons. By 1920, the records of 19 states gave returns for crude gypsum mined amounting to 3,129,142 tons.

California produced in 1895 a tonnage of 5158, and, in 1920, this was increased to 20,507 tons.

Southern California imported from Nevada and Utah, in 1921, approximately 120,000 tons, of which 95% came from Nevada.

And yet, within the counties of Southern California, and, particularly, in Riverside, San Bernardino and Imperial counties, there exist literally, not thousands, but millions, of tons of commercial rock gypsum. The deposits that contain these enormous amounts occur in the arid regions of the Mojave and Colorado deserts, and, for one reason only—lack of transportation—have they heretofore not been developed.

The gypsum that is imported into Southern California is used almost entirely for wall plaster and plaster board, and comes from Arden, Arrowhead, and Mound House, in Nevada, and from Nephi, Utah. These deposits are all either on the railroads, or within a very few miles of them, and for this reason solely, and not on account of any superiority over the Southern California deposits, have they been developed.

Gypsum in Southern California is used as land plaster, as a retarder for cement, as wall plaster and for plaster board.

As land plaster, crude gypsum is finely ground and used as a fertilizer. About 7000 tons was used as fertilizer, last year, the greater part of which came from the deposit at Amboy.

In the cement industry, from 2 to 2½ per cent raw gypsum is used as a retarder in the setting of cement. For this purpose, crude gypsum is crushed to pass a two-inch ring and is added to the cement clinker as it comes from the roaster. 12,000 to 14,000 tons are used by the cement plants in Southern California as a retarder, and the major part of this also came from Amboy.

Of the 120,000 tons of gypsum that came from Nevada and Utah into Southern California, the larger part of this was sold as wall plaster, and the balance as wall board.

There are now in Los Angeles four companies which manufacture wall board, and undoubtedly there will be a gradual expansion of the wall board industry.

As yet the amount of gypsum used as tile, block, or stucco in Southern California is comparatively small, yet there is a very large industrial field to be developed along these lines. This is especially true now, as more and more attention is being directed to the use of fire resisting materials in construction.

GYPSUM DEPOSITS.

The gypsum deposits of Southern California may be divided into four groups, according to their origin—efflorescent deposits, periodic lake deposits, interbedded deposits and crystallized veins, or selenite. Of these, all but selenite may have a local value.

The efflorescent deposits are widely distributed from the Tehachapi Mountains through to Los Angeles County. They overlie a variety of Tertiary sediments of fine and coarse sandstone and shales. In general, these have little economic value. However, locally they may be utilized where transportation is not an obstacle.

The deposit at Amboy is an excellent example of a periodic lake deposit. However, it is the interbedded deposits of the Palen, Maria, Avawatz and Fish mountains, which are of most economic value.

There are three very large deposits of gypsum in Southern California, each of which has tonnages running into the millions, and which are of especial interest:

Riverside County.

In the Maria Mountains, seventeen miles south of Blythe Junction, a station on the Parker cutoff, of the Atchison, Topeka and Santa Fe Railroad, lie the holdings of the United States Gypsum Company. These are situated in the southwest corner of T. 3 S., R. 21 E. and in the northwest and southeast corners of T. 4 S., R. 21 E., S. B. B. and M. These have been partially developed by open cuts and shafts; as they lie but a few miles from the Atchison, Topeka and Santa Fe Railroad, they are of great economic importance.

Imperial County.

In the northwestern edge of the Fish Creek Mountains, in Sec. 29, T. 13 S., R. 9 E., S. B. M., the Imperial Gypsum Company has 400 acres of an immense deposit of rock gypsum. As the thickness of this deposit is over 100 feet and can easily be mined by quarrying methods, mining costs should be exceedingly low. The company at present is building a narrow-gauge railway from a station, Maria, on the San Diego and Arizona Railroad, to the deposit, a distance of about 25 miles. Maria is about 18 miles west of El Centro. The company is now erecting a crushing plant of 250 tons capacity at Maria, and later proposes building a calcining unit.

San Bernardino County.

In the Avawatz Mountains, not far from the northern boundary of San Bernardino County, and at the extreme southern end of Death Valley, lie immense deposits of gypsum. These are about ten miles west of the Tonopah and Tidewater Railroad. The Avawatz Salt and Gypsum Company has locations in sections 15, 22, 23, 25, and 26, T. 18 N., R. 5 E., S. B. M. This company has completed extensive railroad surveys from the deposits to the Tonopah and Tidewater Railroad, showing a line 17 miles in length could be easily constructed. The possibility of not only mining gypsum, but also salts, which occurs in immense quantities on its claims, gives the property a very great potential value.

Other Counties.

Besides the deposits referred to, all of which have tonnages which run into the millions, gypsum occurs in other localities in the above counties, as well as in Inyo, Kern, Los Angeles, Orange, Santa Barbara, and Ventura counties. These deposits are described in detail in Reports XIV, XV, XVII of the State Mineralogist. Also, in Bullein No. 697 of the United States Geological Survey.

Conclusion.

I have endeavored in the above to give a brief, but accurate, view of the gypsum industry, showing the present consumption and the available deposits in Southern California. It is easy to see that the market for gypsum is not unlimited by any means at the present time, and that our gypsum deposits will probably last far into the future. That there will be an increasing demand for wall plaster and plaster board on the Pacific Coast is practically assured. The possibility of creating a further market for wall board in the Orient, Australia, and South America, is simply a matter of educating those countries to its use.

Appended below is a short historical sketch and a description of the chemical and physical properties of gypsum, which has been abstracted from the bulletins of the United States Geological Survey, to whom thanks are duly acknowledged:

Historical.

The peculiar properties of gypsum for certain uses have been known to man from the earliest of recorded time. The Egyptians, over 4000 years ago, made plaster of calcined gypsum, the same as plaster of Paris of today. Some of the plaster work in the Pyramids is hard and durable today. The sculpture of the Assyrians was made of alabaster. White rock gypsum or alabaster has been used in Europe for centuries, for ornamentation of buildings, especially that of the cathedrals, and is today still used in large quantities for sculpture in Italy.

Calcined gypsum has had no extensive use until within the last half century, though utilized for several centuries for making plasters and casts. It is somewhat over 100 years ago that gypsum was first quarried in the United States. As early as 1792, gypsum was discovered in central New York, and, in 1808, a company was formed to sell it as land plaster, but not until 1892 was the first production of gypsum plaster recorded in New York. Following New York, gypsum was found in Virginia, and, as the population of the United States gradually crept westward, deposits were found by the settlers in Michigan, Ohio, and Iowa. In 1835, the use of gypsum as land plaster was advocated. In 1840, deposits were found near Grand Rapids, Michigan, and, in 1850, gypsum was being mined at Sandusky, Ohio. Iowa began to produce gypsum in 1872, and California, in 1875.

Chemical and Physical Properties.

Gypsum is a common mineral, and is found widely distributed in the United States. It occurs both massive and crystalline. The crystalline form, known as selenite, can be split into layers or sheets, and any variety of gypsum is so soft as to be scratched with a finger nail. The chief commercial value of gypsum is due to the fact that if calcined and then mixed with water, it will set and harden, thus making its use ideal for wall plaster. Chemically, gypsum is a hydrous calcium sulphate, having the chemical formula $\text{Ca SO}^4\ 2\ \text{H}^2\ \text{O}$, which, reduced to its component parts,

$$\text{Gypsum Ca SO}^4\ 2\ \text{H}^2\ \text{O} \left\{ \begin{array}{ll} \begin{array}{l}\text{Calcium Sulphate}\\ \text{Ca SO}^4 = 79.1\%\end{array} & \left\{\begin{array}{l}\text{Lime}\\ \text{Ca O} = 32.5\%\\ \\ \text{Sulphur Trioxide}\\ \text{SO}^3 = 46.6\%\end{array}\right. \\ \begin{array}{l}\text{Water}\\ \text{H}^2\ \text{O} = 20.9\%\end{array} & \end{array}\right.$$

Pure Gypsum, or sulphate of lime, is seldom found pure in nature. Nearly all gypsum deposits contain oxides of iron and aluminum, carbonates of calcium, magnesium, and other impurities. Anhydrite, or Ca SO^4, is often found with gypsum, either disseminated through it, or occurring in separate masses. The specific gravity of pure gypsum is 2.3 to 2.33, and pure rock gypsum is white, while selenite is colorless and transparent or translucent. Owing to impurities, however, gypsum varies in color from gray to black, from flesh pink to red, and brown, and some is yellow or pale blue. However, pure powdered gypsum is always white.

Gypsum as selenite crystallizes according to the forms of the monoclinic system. Gypsum is soluble in hydrochloric acid, but does not effervesce, or gelatinize. Gypsum occurs in four different forms, as rock gypsum, gypsite, selenite, and satin spar.

Rock or massive gypsum is the variety of most economic value, and occurs interbedded in sedimentary rocks, and is composed of minute, even microscopic crystals, which make a generally opaque rock. When pure, it is white. However, commonly, it is more often pink, gray or brown, or buff. Rock Gypsum that is white and fine grained is known as alabaster, and is suitable for sculpturing.

Gypsite, or earthy gypsum, is soft, incoherent, impure gypsum, formed on the surface from gypsiferous water. It ranges from material as fine as powder through to a sandy or slightly consolidated form. In color, it may be gray, brown, pink, or, where it contains much iron, red.

Selenite occurs in distinct crystals. These have been known to be over 4 feet long, but these, however, are rare. Pure selenite is colorless and transparent, easily splits into sheets, and is often mistaken for mica. However, the sheets are not elastic, like mica, and thus can be easily distinguished from it. Satin spar is a crystalline form of needle-like fibres. It occurs in narrow veins, or seams, seldom over 3 or 4 inches thick, either in massive gypsum deposits, or in the wall rocks near these. Satin spar is usually white or pink.

MINE ASSESSMENT YEAR.

By C. McK. Laizure.

That there is still a great deal of confusion in the minds of holders of unpatented mining claims regarding the periods in which the annual assessment work must be performed, is apparent from the large number of inquiries received by the Bureau in regard to the change from the calendar year to the fiscal year basis.

Federal government bureaus, technical magazines, and daily papers in mining districts have also been besieged with inquiries.

The text of the law now in effect was published in the February issue of 'Mining in California,' and it is believed that the mining public is fairly familiar with the act itself, but its interpretation has been the subject of much discussion, and it will be fortunate, indeed, if it is not the cause of unnecessary litigation.

In an endeavor to clarify the situation the following graphic chart has been prepared in the hope that by visualizing the calendar years and assessment periods, their relation will be shown more clearly and the overlapping of the two explained.

Under the old law the first work required on a *new* location had to be performed before the end of the 'year' following the 'year' in which the claim was located.

This period, under the old law, coincided with the calendar year and began at 12 a.m. the first of January next succeeding the calendar year in which the claim was located. The period is now, however, represented by the 'assessment year' which corresponds to the fiscal year, and comprises each twelve months between noon July 1st and noon July 1st annually; with the exception of the transition period of eighteen months between January 1, 1920, and July 1, 1921. For the purpose of figuring when the first work must be done this eighteen-month long 'year' merely worked to the advantage of the locator, by giving him an additional six months time for the '1920 work,' while the change was being made.

By referring to the diagram, it will be readily seen just how the 'assessment years' relate to the 'calendar years.'

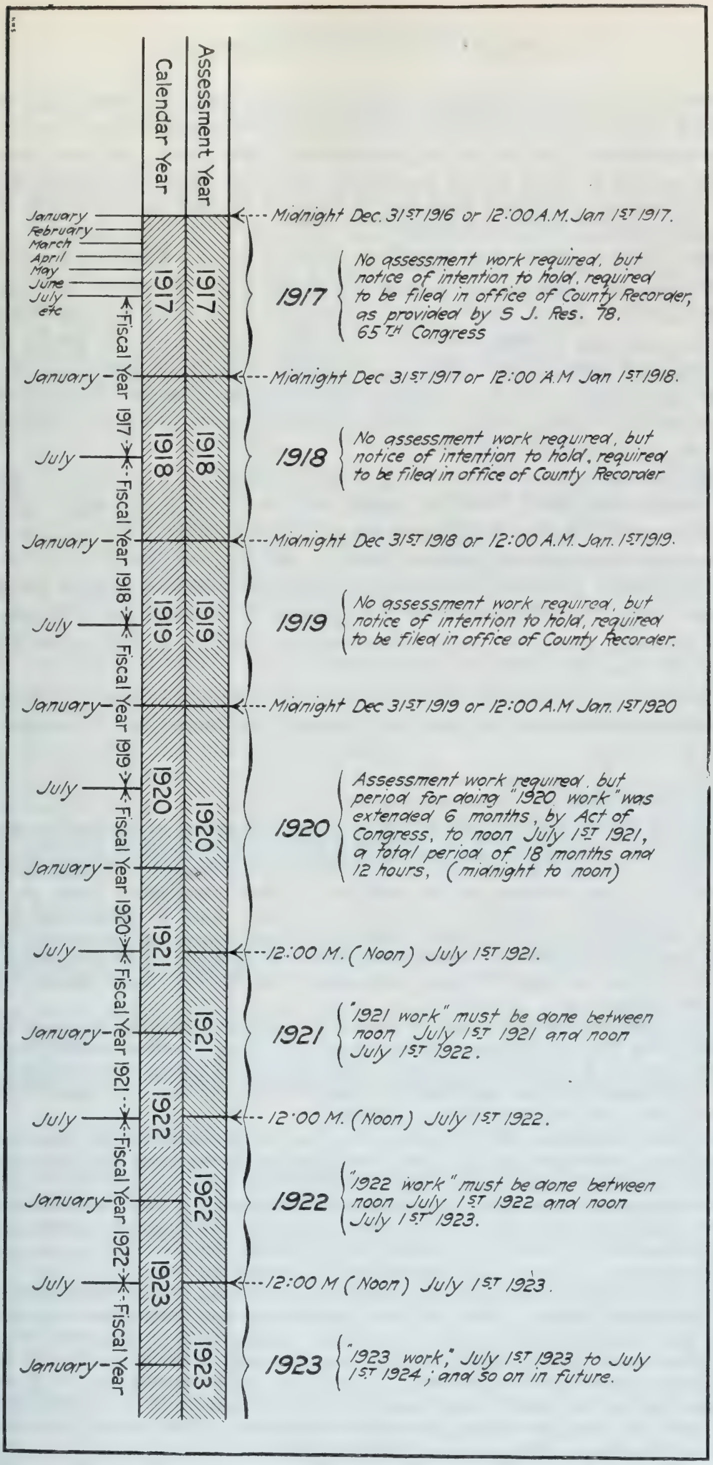

Calendar Year
Assessment Year
January
February
March
April
May
June
July
etc
Fiscal Year 1917
Fiscal Year 1918
Fiscal Year 1919
Fiscal Year 1920
Fiscal Year 1921
Fiscal Year 1922
Fiscal Year
January
July
1917
1918
1919
1920
1921
1922
1923
Midnight Dec. 31ST 1916 or 12:00 A.M. Jan 1ST 1917.
1917 No assessment work required, but notice of intention to hold, required to be filed in office of County Recorder, as provided by S J. Res. 78. 65TH Congress
Midnight Dec 31ST 1917 or 12:00 A.M Jan 1ST 1918.
1918 No assessment work required, but notice of intention to hold, required to be filed in office of County Recorder
Midnight Dec 31ST 1918 or 12:00 A.M. Jan. 1ST 1919.
1919 No assessment work required, but notice of intention to hold, required to be filed in office of County Recorder.
Midnight Dec 31ST 1919 or 12:00 A.M Jan. 1ST 1920
1920 Assessment work required, but period for doing "1920 work" was extended 6 months, by Act of Congress, to noon July 1ST 1921, a total period of 18 months and 12 hours, (midnight to noon)
12:00 M. (Noon) July 1ST 1921.
1921 "1921 work" must be done between noon July 1ST 1921 and noon July 1ST 1922.
12:00 M. (Noon) July 1ST 1922.
1922 "1922 work" must be done between noon July 1ST 1922 and noon July 1ST 1923.
12:00 M (Noon) July 1ST 1923.
1923 "1923 work," July 1ST 1923 to July 1ST 1924; and so on in future.

Diagram showing relation between 'calendar years' and periods for performing annual assessment work due to changing period from the calendar year to the fiscal year, beginning July first of each year.

The owner of a claim located at any time during the year 1919 would have until noon July 1, 1921, in which to perform his first assessment work, a maximum period of approximately two years and six months, if the claim was located at the beginning of 1919, and a minimum period of approximately eighteen months, if located at the end of 1919.

If located during the calendar year 1920, it would be located within the '1920 assessment period' and the owner would have until the end of the following 'assessment period' or fiscal year in which to complete his first work, or until noon July 1, 1922, as indicated on the diagram.

A claim located between January 1, 1921, and July 1, 1921, would still be located within the '1920 assessment period or year,' they being opposite each other in the diagram, and the first work would have to be completed by noon, July 1, 1922, which is the end of the succeeding or '1921 assessment period or year.'

A claim located after July 1, 1921, and before July 1, 1922, is located in the 'fiscal year 1921,' which begins and ends on those dates, and the first work would have to be completed by July 1st of the succeeding fiscal year, or assessment period; that is, by July 1, 1923.

There appears to be little question regarding old locations or claims that have been in existence for a number of years; the difference of opinion arising over the work required on locations made during the change.

The following statement and comment on the same was published by the American Mining Congress in General Bulletin No. 20 under date of May 13, 1922:

"MINING ASSESSMENT.

"Conflicting opinions having arisen as to the performance of assessment work on mining claims, Acting Secretary of Interior Finney has rendered a decision in reply to a request by Senator Bursum of New Mexico. The Senator's request was based on an inquiry of an Arizona miner relative to when assessment work on mining claims located between January 1 and July 1, 1921, must be performed to avoid danger of relocation. The Attorney General of Arizona ruled that such locators would be required to perform annual assessment work prior to July 1, 1922. The opinion of Acting Secretary Finney coincides with that of the Arizona Attorney General and follows:

'This is a question which can not be settled by the opinion of the Attorney General of the State nor by the Secretary of the Interior, as the question would arise, if at all, in the event of a relocation of such a claim and upon adverse proceedings, in the courts. However, I give my opinion for what it is worth, and state that it coincides with that of the Attorney General of Arizona.

'The statute (42 Stat. 186) provides that the period within which work shall be performed shall commence at 12 o'clock meridian on the first day of July succeeding the date of location of such claims. A further proviso is to the effect that in all such valid existing claims the annual period ending December 31, 1921, shall continue to 12 o'clock noon, July 1, 1922. The latter proviso was designed, to take care of existing claims and to give an extension of six months within which work might be performed thereon. One of the reasons for the latter proviso was to avoid having the year within which assessment work must be performed end at different times for different classes of claims. As to the first provision of law, it seems clear that it was intended to permanently change the time within which annual assessment work upon mining claims must be performed, so as to have the year begin and end with the first of July, instead of the first of January as heretofore. The requirement in the statute is that the year within which assessment work is required to be performed begins on the first day of July succeeding the date of location. Therefore, if a claim were located, say in June, 1921, the year within which work was required to be done began on the next first of July, or July 1, 1921, and to avoid relocation must have been performed during the year beginning July 1, 1921, and ending July 1, 1922.'

"The American Mining Congress is not convinced that the opinion of Acting Secretary Finney above referred to on mining assessment will be upheld by the courts, nevertheless it urges holders of all claims located between January 1, 1921, and July 1, 1921, to do annual assessment work thereon before July first of this year."

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coördination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Summary of Operations, California Oil Fields, February, 1922, Vol. 7, No. 8.

Mining in California, April, 1922 (monthly), Vol 18, No. 4.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XI, State Mineralogist	2
Report XIV, State Mineralogist	4
Report XV, State Mineralogist	3
Report XVII, State Mineralogist	14
Mines and Mineral Resources of Del Norte, etc.	1
Mines and Mineral Resources of Imperial, etc.	3
Mines and Mineral Resources of Alpine, etc.	2
Mines and Mineral Resources of Butte, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	3

Publications	Number distributed
Mines and Mineral Resources of Monterey, etc.	5
Mines and Mineral Resources of San Bernardino, etc.	3
Mines and Mineral Resources of Shasta, etc.	1
Mines and Mineral Resources of Nevada County	10
Mines and Mineral Resources of Plumas County	4
Mines and Mineral Resources of Sierra County	3
Bulletin No. 6, California Gold Mill Practices	3
Bulletin No. 23, Copper Resources of California	3
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	5
Bulletin No. 50, Copper Resources of California	3
Bulletin No. 72, Geologic Formations of California	15
Bulletin No. 75, Mining Laws, United States and California	75
Bulletin No. 78, Quicksilver Resources of California	5
Bulletin No. 85, Platinum and Allied Metals in California	7
Bulletin No. 89, Petroleum Resources of California, with special reference to unimproved area	205
Bulletin No. 90, California Mineral Production for 1920	70
Preliminary Report No. 8, Review of Mining in California during 1921	100
Mining in California (Monthly) Vol. 18, No. 3, March, 1922	240
Mining in California (Monthly) Vol. 18, No. 4, April, 1922	1960
County Maps and Registers of Mines	3
El Dorado Forest Map	4
Madera Forest Map	1
Placer Forest Map	4
Shasta Forest Map	1
Sierra Forest Map	2
Siskiyou Forest Map	6
Tuolumne Forest Map	2
Lake Map	1
Desert Map	4
Inyo Geological Map	3
Amador Mineral Map	1
Calaveras Mineral Map	3
Tuolumne Mineral Map	2
Forest Map, unmounted	1
Forest Map, mounted	1
Geological Map of California, unmounted	1
Geological Map of California, mounted	10
Reg. Oil Wells, Los Angeles County	1
Colored Map of California, showing generalized classification of land regarding oil possibilities	37
Oil Field Maps	418

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 750 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

California produces commercially at least fifty different mineral substances, with a total annual value of nearly $250,000,000. There are several thousand operating properties, including mines, quarries, oil and gas wells, mineral springs, gravel pits, mills, and smelters; hence, the task of compiling accurate and dependable statistics covering their activities is not a simple one.

Some figures of the 1921 production were given in the April issue of 'Mining in California,' and additional data are presented herein; but as we have still to receive reports from a few of the operators it is not yet possible to compile the final figures for last year.

ALUMINUM.

Bibliography: Bulletins 38, 67. U. S. G. S., Min. Res. of U. S.

To date, there has been no commercial production of aluminum ore in California. The first authentic find of bauxite in this state was noted in the April issue of 'Mining in California' (see page 198, *ante*; also 'Pacific Mining News,' p. 13, May, 1922).

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence, commercially, in the production of the metal: bauxite (to which may be added the related, hydrated oxides, hydrargillite and diaspore), and cryolite. Cryolite is found in commercial quantities only in South Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been, for some years, the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0%–10%. Besides its reduction to the metal, bauxite is also utilized in the manufacture of: aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive; and in the refining of oil (stated to be of growing importance). The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 France led.

Because of its light weight (2.58 specific gravity), the metal, aluminum, has many important industrial uses, particularly in the manufacture of aeroplanes, airships, automobiles, cooking utensils, and electrical apparatus. The use of aluminum dust in place of zinc dust for precipitating precious metal from cyanide solutions is increasing. In the Thermit process of welding and casting, aluminum in fine grains or filings is mixed with the oxide (usually iron oxide) to be reduced.

Present quotations for aluminum are 17c–20c per pound according to grade, for the refined metal.

ANTIMONY.

Bibliography: State Mineralogist Reports VIII, X, XII, XIII, XIV, XV, XVII, Bulletin 38.

Production of antimony in California has been irregular, and small in amount except during the year 1916 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo, and San Benito counties, and other occurrences have been noted in Nevada, Riverside, and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

California producers claim that they can not operate profitably unless the price of antimony be above 12 cents per pound. Present New York quotations are around 5 cents per pound.

Pure antimony metal, and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper).

The production of antimony in California by years since 1887 has been as follows:

Year	Tons	Value
1887	75	$15,500
1888	100	20,000
1889	--------	--------
1893	50	2,250
1894	150	6,000
1895	33	1,485
1896	17	2,320
1897	20	3,500
1898	40	1,200
1899	75	13,500
1900	70	$5,700
1901	50	8,350
1902	--------	--------
1915	510	35,666
1916	1,015	64,793
1917	158	18,786
1918	--------	--------
Totals	2,363	$199,050

ARSENIC.

Bibliography: Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing. The occurrence of realgar (AsS) has also been noted (see page 197, *ante*. To date, there has been no commercial output of arsenic from California ores. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic.'

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

In 1917, a few pounds of bismuthinite (Bi_2S_3) with associated bismutite ($Bi_2CO_5.H_2O$), was taken out at the United Tungsten Copper mine, in the Morongo district, San Bernardino County. It is associated with scheelite in a contact deposit between limestone and granite.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted,[1] ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

Present quotations for bismuth are $2.00–$2.10 per pound for the refined metal.

CADMIUM.

Biblography: U. S. G. S., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from California ore. Cadmium there occurs associated with zinc sulphide, sphalerite, probably as the sulphide, greenockite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are $1.00–$1.25 per pound for the refined metal.

---

[1] Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

COBALT.

Bibliography: Report XIV; Bulletin 67. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial deposits have been developed. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%.

The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

Present quotations for cobalt are $3.00–$3.25 per pound for the refined metal.

MOLYBDENUM.

Bibliography: Reports XIV, XVII. Bulletin 67. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter, is its successful substitution for platinum and platinum-iridium in electric contact-making and breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate, the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland, and Norway, with some also from Canada.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war, 1916–1918. Some development work has recently been done on a high-grade deposit at the head of the Kaweah River, Tulare County.

The 1917 output included some concentrates assaying up to 58% MoS_2, but the bulk of it was 1.5% ore which was shipped to Denver, Colorado, for concentration. That production came mainly from Shasta County, with smaller amounts from Inyo, Mono and San Diego counties. There were two concentrating plants built in California—one in each of the above first and last-named counties.

In the spring of 1918, a flotation plant operated for a short time by a lessee on the Boulder Creek mine, near Gibson Siding, Shasta County, made a small amount of 90% MoS_2 concentrate. The ore treated carried 2.6% MoS_2. There has been none produced in California since 1918.

Present quotations for molybdenum ore are @ 50¢ per pound for 85% MoS_2 concentrates.

The California production of molybdenum ore by years is summarized in the following tabulation:

Year	Tons	Value
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

*300 pounds of 90% MoS_2 concentrate.

NICKEL.

Bibliography: Reports XIV, XVII. U. S. G. S., Bulletin 640–D.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work, but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are 30¢–39¢ per pound, according to grade and quantity.

TIN.

Bibliography: Reports XV, XVII. Bulletin 67.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets having been taken out.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by de-tinning scrap and old cans.

Total output of tin in California:

Year	Pounds	Value
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Reports XV, XVII. Bulletins 38, 67. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc., Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübnerite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent. Burma, the largest producer, reported[2] for 1917–1919, yields of 4,537, 4,443, and 3,577 tons of wolframite concentrates, respectively, most of which was obtained from placers, in part associated with cassiterite (tin oxide).

Imports of foreign tungsten ores into the United States during 1921 amounted to 1,441 long tons, valued at $276,757, compared with 1,740 long tons, at $779,593, in 1920, 8,400 long tons, at $6,261,190, in 1919, and 10,362 long tons valued at $11,409,237, in 1918, which ores are duty free. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the present low market prices, practically all of the tungsten mines in the United States have been closed down since the middle of 1919. The quotations during 1921 ranged around $2.50–$3.00 per unit. Present quotations are $2.25–$2.50 for Chinese ore, and $3.00 for Bolivian, with a minimum of 60%. The tariff act of 1922, now before the U. S. Senate, proposes a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys.

The value of the ore is based upon the content of tungstic trioxide (WO_3), and quotations are commonly made per unit (each 1%) of WO_3 present.

In California in 1920–1921, there was no production of tungsten, neither of ore nor concentrates, for the first time since the beginning of tungsten mining in this state. The tonnages here shown are recalculated to a basis of 60% WO_3. Concentrates usually carry 59% to 63%. Previous to 1915, a single company produced almost all of California's tungsten. During the latter part of 1915, and the early months of 1916, because of the high prices prevailing, prospecting was much stimulated, and the known tungsten-bearing areas were considerably extended both in San Bernardino and Kern counties. In the Clark Mountain and New York Mountains districts in eastern San Bernardino County, wolframite and hübnerite are the principal ores, with some scheelite, while at Atolia it is scheelite only. Scheelite is also the tungsten mineral in Inyo County near Bishop, and three concentrating mills have been in operation there. The Nevada County ore is scheelite.

---

[1] U. S. G. S. Bull. 652, p. 32.

[2] U. S. Commerce Reports, No. 78, April 5, 1921, p. 95.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys, permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high-speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium, are sometimes also included. Tungsten compounds are used in the manufacture of colors.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%-85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3,267° C. (5,913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

The annual amount and value of tungsten produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1914	420	$180,575
1906	485	189,100	1915	962	1,005,467
1907	287	120,587	1916	2,270	4,571,521
1908	105	37,750	1917	2,466	3,079,013
1909	577	190,500	1918	1,982	2,832,222
1910	457	208,245	1919	214	219,316
1911	387	127,706	1920	----------	----------
1912	572	206,000			
1913	559	234,673	Totals	11,800	$13,221,475

VANADIUM.

Bibliography: Report XV. Bulletin 67. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has as yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernarindo County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% $V_2\ O_5$ was opened up. Late in 1917, some ore carrying lead vanadate was discovered in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties.

The principal use of vanadium is as an alloy in steels, especially in tool steel and in those varieties where resistance to repeated strains is required. Present New York quotations for vanadium ore are @ $1 per pound of contained V_2O_5 (guaranteed minimum of 18% V_2O_5).

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, approximately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

Among the specimens received recently, and catalogued, for the Museum are the following:

19608. *Gold*-bearing sulphide ore (2 pieces). From Columbus Mine, West Point District, Calaveras County, Cal., by W. W. Gibson.

19608-b. *Gold*-bearing, sulphide ore. From Washington Mine, near Sheep Ranch, Calaveras County, Cal., by Fred Walker.

19609 to 19615, inclusive. *Talc* ($H_2Mg_3Si_4O_{12}$, hydrous magnesium silicate). 'Banco' (white), high-grade, massive foliated; 'Grigio' (gray), foliated; Powdered 'ventilato' (air-floated), high-grade. From Cavé Roussa, Comune di Roure; Cavé 'Sapatle,' Comune di Praly; Cavé Malzas, Comune di Faetto; Cavé Fontane, Comune di Salza; Pinerolo, Italy, by Societa Talco é Graphite Val Chisone, Pinerolo, Italy.

19616. Mainly *Pyrargyrite* (Ag_3SbS_3, silver sulph-antimonide, dark 'Ruby Silver Ore.' Assay value $6000 per ton). From 450-foot level, Rand mine, San Bernardino County, near Randsburg, by California Rand Silver, Inc., Randsburg, Cal.

19617. *Oil Shale.* Yields oil of 22° Baumé on destructive distillation. From Casmalia, Santa Barbara County, Cal., by F. D. Gore, Santa Maria, Cal.

19618. *Scheelite* ($CaWO_4$, calcium tungstate. Massive, high-grade, with Calcite). From Atolia Mine, San Bernardino County, Cal., by Atolia Mining Co., San Francisco.

19619 and 19620. *Molybdenite* (MoS_2, molybdenum sulphite). In granodiorite, with Pyrite associated. Crystals, high-grade. From head of Kaweah River, Tulare County, Cal., by Kent S. Castle, Oakland, Cal.

19621. *Petzite* $(Ag,Au)_2Te$—silver-gold telluride with Ag :Au : :3 :1. Free Gold associated. From Porphyry Dike Mine, near Callahan, Siskiyou County, Cal., by Fippen & Hayden, Callahan, Cal.

19622 and 19623. *Gold Ore.* (Gold-bearing Pyrite and Quartz, from 1700 and 5400-foot levels.) From Empire Mines, Grass Valley, Nevada County, Cal., by Empire Mines and Investment Company, Grass Valley, Cal.

19624. *Gold Ore.* Gold-bearing Pyrite (FeS_2) and Galena (PbS), with Quartz. From Uncle Sam Mine, Shasta County, Cal.

19626. *Crocidolite* (complex sodium-iron silicate, of amphibole group). From Pine Flat, Sonoma County, Cal., by W. P. Moore, Pine Flat, Cal.

19628 and 19629. Chrysotile *Asbestos* ($H_4Mg_3Si_2O_9$, hydrous magnesium silicate, fibrous serpentine). Veins of short fibre attached to country rock; 'Crude' asbestos, clean fibres hand-cobbed from rock. From south of Copperopolis, Calaveras County, Cal., by Pacific Asbestos Corporation, via Copperopolis, Cal.

19630 and 19631. *Bornite* (Cu_3FeS_3, copper-iron sulphide, 'Peacock Copper,' high-grade). From Engels and Superior mines, of Engels Group, Plumas County, Cal., by Engels Copper Mining Company, San Francisco.

19632. *Chalcopyrite* ($CuFeS_2$, copper-iron sulphide. High-grade). From Engels Group, Plumas County, Cal., by Engels Copper Mining Company, San Francisco.

19633 and 19634. *Diatomaceous Earth.* Sawed block of 'Celite'; burned brick of 'Celite.' For insulation purposes. From Lompoc, Santa Barbara County, Cal., by Celite Products Company, Los Angeles, Cal.

19637. *Quicksilver* (Hg, or Mercury. Retorted, pure metal. The only metal which is liquid at ordinary atmospheric temperatures). From New Idria Quicksilver Mining Company, Idria, Cal.

19640 and 19641. *Gold ore* (high-grade, carrying very fine free gold. Assay value stated to be $5,000 per ton). Free *Gold* (panned from an equal amount of rock, 5 lb.). From Juniper Mine, Lassen County, Cal., by Juniper Mining Company, Hayden Hill, Cal.

19642. *Orbicular Gabbro.* (Structure revealed by weathering.) From Stokes Mountain, near Cutler, Tulare County, Cal., by Gordon Surr, Porterville, Cal.

19643. *Asbolite* ('earthy cobalt,' a varety of wad, impure manganese oxide, carrying Cobalt Oxide). Coating on Serpentine. From old Chrysoprase workings, near Deer Creek, southeast from Porterville, by Gordon Surr, Porterville, Cal.

19644. Native *Silver* in Calcite. From El Dorado County, Cal., by C. H. Trester, Oroville, Cal.

19645. *Dumortierite* (a basic aluminum silicate, perhaps $Al_8Si_3O_{18}$, with part of Al replaced by Boron). From near Brawley, Imperial County, Cal., by Chas. E. Nice, Brawley, Cal.

19646. Amphibole *Asbestos* (calcium-magnesium metasilicate. Fibrous Tremolite). From Placer County, Cal., by Ben Rossi, Sacramento, Cal.

19647. Amphibole *Asbestos* (calcium-magnesium metasilicate. Fibrous Tremolite). From near Acme Station, Inyo County, Cal., by Henry Lang, Tecopa, Cal.

19648. *Coal.* From near Baker's Beach, San Francisco, Cal., by H. L. Benedict.

19649. *Pyrolusite* (MnO_2, manganese dioxide. Pseudomorph after manganite $Mn_2O_3H_2O$, by loss of water). From Lake Valley Mining District, New Mexico, by Clement C. Edwards, San Rafael, Cal.

19650. *Pyrite* (FeS_2, iron sulphide, crystals forming a druse on Quartz, SiO_2, crystals). From Mocking Bird Mine, near Mariposa, Mariposa County, Cal., by J. A. Schroeder, Mariposa.

19651. Red *Shale.* From Camp 9 on Arroyo Mocho, near Livermore, Alameda County, Cal., by W. S. McLean, San Francisco.

19652. 'California' *Travertine*, crushed and sized, for use in terrazzo. From near Tolenas, Solano County, Cal., by W. S. McLean, San Francisco.

During the month a total of 312 visitors signed their names on the Museum register and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

A radioactive kaolinized rock from Imperial County was among the interesting samples recently received at the laboratory. The general appearance of the rock is unattractive, resembling an ordinary altered igneous material with a faint incrustation of a yellow mineral which occurs in spots and also somewhat disseminated through the mass. This yellow mineral resembles carnotite (hydrous oxide of vanadium, uranium, and potassium); but chemical tests made on the extremely small amount available in the sample gave reactions for uranium phosphate—no vanadium being detected. A request has been made for a larger sample, and details as to locality, etc., so that further tests can be made.

A total of 320 samples were received and determined during the thirty-day period covered by this report. A list of those of possible value, judged from the sample submitted only, is appended.

05–141	Gold quartz, with some pyrite and arsenopyrite.
05–142	Coquimbite, and fibreferrite.
05–143	Copper-nickel ore.
05–144	Schist; contains gold.
05–145	Arsenopyrite; contains some gold.
05–146	Copper-silver ore.
05–147	Fluorite.
05–148	Lead-silver ore; contains a little gold.
05–149	Clay (Kaolinized material); also limestone.
05–150	Gold quartz.
05–151	Chrysotile asbestos.
05–152	Galena (lead ore).
05–153	Talc.
05–154	Bauxite.
05–155	Barite, good grade.
05–156	Gold quartz.
05–157	Alunogen; impure.
05–158	Copper-gold ore.
05–159	Scorodite (hydrous ferric arsenate); impure.
05–160	Gold quartz; also limestone.
05–161	Gold quartz; contains some silver.
05–162	Barite; grinds white.
05–163	Gold quartz.
05–164	Barite
05–165	Chrysotile asbestos; short fibre.
05–166	Diatomaceous earth.
05–167	Crystallized quartz, penetrated with crystals of black tourmaline.
05–168	Kaolinized material (fire clay); also lime carbonate.
05–169	Quartz; contains gold, silver and lead.
05–170	Arsenopyrite; also scorodite and galena.
05–171	Gypsum; fair grade.
05–172	Manganese oxide.

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geol. Survey Bulletins:
- No. 722-F—Metalliferous Lodes in Southern Seward Peninsula, Alaska. By S. H. Cathcart.
- No. 725-J—Ore Deposits of the Sierrita Mountains, Pima County, Arizona. By F. L. Ransome.
- No. 726-E—Geologic Structure of Parts of New Mexico. By N. H. Darton.
- No. 730-A—Peneplains of the Front Range and Rocky Mountain National Park, Colorado. By Willis T. Lee.
- No. 735-C—Bonanza Ores of the Comstock Lode, Virginia City, Nevada. By Edson S. Bastin.

U. S. Geol. Survey Mineral Resources:
- Quicksilver in 1920. By F. L. Ransome with a Supplementary Bibliography by Isabel P. Evans.
- Sulphur and Pyrites in 1919. By Philip S. Smith.
- Mica in 1920. By B. H. Stoddard.
- Tin in 1920. By Bertrand L. Johnson.
- Gold, Silver, Copper and Lead in Alaska in 1920. By Alfred H. Brooks.

U. S. Geol. Survey Professional Papers:
- No. 129-D—Stratigraphic Sections in Southwestern Utah and Northwestern Arizona. By John B. Reeside, Jr., and Harvey Bassler.
- No. 129-F—The Foraminifera of the Mint Spring Calcareous Marl Member of the Marianna Limestone. By Joseph A. Cushman.
- No. 129-G—The Flora of the Woodbine Sand at Arthur Bluff, Texas. By Edward Wilber Berry.
- No. 129-H—Geology of the Lower Gila Region, Arizona. By Clyde P. Ross.
- No. 129-I—The Flora of the Cheyenne Sandstone of Kansas. By Edward Wilber Berry.

U. S. Bureau of Mines Reports of Investigations:
  Serial No. 2331—Water Gas Tar Emulsions. By Wm. W. Odell (Gas Engineer, Bureau of Mines).
  Serial No. 2332—Analytical Distillations of Typical Shale Oils. By Martin J. Gavin (Oil-Shale Technologist, Bureau of Mines).
  Serial No. 2333—Epsomite. By Raymond B. Ladoo (Mineral Technologist, Bureau of Mines).
  Serial No. 2334—Fatalities at Coal Mines in February, 1922. By W. W. Adams (Statistician, Bureau of Mines).
  Serial No. 2335—Tests of Hand Extinguishers of Zinc-Dust Fires. By S. H. Katz (Assistant Physical Chemist, Bureau of Mines) and J. J. Bloomfield (Junior Chemist, Bureau of Mines).
  Serial No. 2336—Bibliography of Literature on Sampling. By W. J. Sharwood, and W. W. vonBernwitz.
  Serial No. 2337—The Northwest Experiment Station of the Federal Bureau of Mines. By Clyde E. Williams (Superintendent, Northwest Experiment Station, Bureau of Mines).
  Serial No. 2338—Physiological Effects of Exposure to Low Concentrations of Carbon Monoxide. By R. R. Sayers (Chief Surgeon, U. S. Bureau of Mines, P. A. Surgeon, U. S. Public Health Service); F. V. Meriwether (Car Surgeon, U. S. Bureau of Mines, A. A. Surgeon, U. S. Public Health Service); and W. P. Yant (Assistant Chemist, U. S. Bureau of Mines).
  Serial No. 2339—Drilling and Dustiness of Metal-Mine Air. By D. Harrington (Supervising Mining Engineer, Bureau of Mines).
  Serial No. 2340—Recent Articles on Petroleum and Allied Subjects. Compiled by E. H. Burroughs (Bibliographer, Bureau of Mines).
U. S. Bureau of Mines Technical Papers:
  No. 258—Production of Gasoline by Cracking Heavier Oils. By E. W. Dean and W. A. Jacobs.
  No. 282—Analysis of Detonating and Priming Mixtures. By C. A. Taylor and W. H. Rinkenbach.
  No. 295—Quarry Accidents in the United States During the Calendar Year 1920. By William W. Adams.
  No. 299—Metal Mine Accidents in the United States During the Calendar Year 1920. By William W. Adams.
  No. 305—Specifications for Petroleum Products Adopted by the Interdepartmental Petroleum Specifications Committee.
U. S. Department of Commerce; Bureau of Standards, Technologic Papers:
  No. 200—An Investigation of Oxyacetylene Welding and Cutting Blow-Pipes, with Especial Reference to Their Design, Safety, and Economy in Operation. By Robert S. Johnston (Engineer Physicist, Bureau of Standards).
  No. 203—Influence of Phosphorous upon the Microstructure and Hardness of Low-Carbon, Open-Hearth Steels. By Edward C. Groesbeck (Associate Chemist, Bureau of Standards).
  No. 205—Tensile Properties of Some Structural Alloy Steels at High Temperatures. By H. J. French (Physicist, Bureau of Standards).
  No. 206—Effect of Heat Treatment on the Mechanical Properties of 1 Per Cent Carbon Steel. By H. J. French (Physicist, W. George Johnson, Assistant Physicist, Bureau of Mines).
U. S. National Museum. Smithsonian Institution Bull. No. 118—Handbook and Descriptive Catalogue of the Collections of Gems and Precious Stones in the United States National Museum. By George P. Merrill.
Idaho Bureau of Mines and Geology Bull. No. 1—The Copper Deposits of the Seven Devils and Adjacent Districts. By D. C. Livingston and F. B. Laney.
Preliminary Report No. 2—Clays of Idaho. By Frank H. S. Keels.
Bull. No. 3—A Reconnaissance in South Central Idaho, Embracing the Thunder Mountain, Big Creek, Stanley Basin, Sheep Mountain, and Seafoam Districts. By J. B. Umpleby and D. C. Livingston.
Illinois Geological Survey Bull. No. 42—Engineering and Legal Aspects of Land Drainage in Illinois. By G. W. Pickels and F. B. Leonard, Jr.
Department of Conservation of Louisiana, Technical Paper No. 1—Mud Laden Tables on Specific Gravities and Collapsing Pressures. By Ben K. Stroud.
Virginia Geological Survey Bull. XXII—The Geology and Coal Resources of Russell County, Virginia. By Chester K. Wentworth.

Minister of Mines Province of British Columbia Annual Report for the Year Ending 31st of December, 1921, being An Account of Mining Operations for Gold, Coal, etc.
The Ontario Department of Mines Thirteenth Annual Report—1921.
Ontario Department of Mines, Vol. XXX, Pt. III—Gowganda and Other Silver Areas. By A. G. Burrows.
Western Australia Geological Survey Bull. No. 83—The Geology and Mineral Resources of the Northwest, Central and Eastern Divisions.
Secretaria De Industria, Comercio Y Trabajo, Boletin Del Petroleo, Vol. XIII, Num. 5, Mexico.
Imperial Geological Survey—Japan, Reports 7, 8, 84.

Societies and Educational Institutions.

The American Mineralogist, March, 1922.
Geographical Review, April, 1922.
University of California, Bulletin of the Department of Geology, Vol. 13, No. 4—Pinnipeds from Miocene and Pleistocene Deposits of California. By Remington Kellogg.
University of Kansas, Science Bulletin, Vol. XIII, No. 1.
University of Washington Engineering Experiment Station, Bull. No. 13—Tension in Track Cables and Logging Skylines. The Catenary Loaded at One Point. By Samuel Herbert Anderson.
Bulletin No. 14—Current Suppression by Means of Parallel Resonance. By Henry Godfrey Cordes.
Bulletin No. 15—Electric Heating of Residences. By Edgar Allen Loew.
Bulletin of the Institution of Mining and Metallurgy, April, 1922.
Boletin Del Cuerpo De Ingenieros De Minas Del Peru No. 102—Observaciones Hidrologicas, 1911–1920, Lima, Peru.
Boletin Del Cuerpo De Ingenieros De Minas Del Peru No. 103—Estadistica Minera En 1920, Lima, Peru.

Books.

Petroleum Register, 1922.

Maps.

U. S. Geol. Survey Topographic Maps:
  Bellaire, Texas.
  Big Stone Gap, Va.
  Bonita Ranch, Cal.
  Booneville, Miss.
  Brownsville, Ky.
  Cape San Martin, Cal.
  Forest, Miss.
  Hephzibah, Ga.
  Houston Heights, Texas.
  Howard Ranch, Cal.
  Keyser, W. Va.-Md.
  Madera, Cal.
  Natchez, Miss.-La.
  Nipomo, Cal.
  Onego, W. Va.
  Park Place, Texas.
  San Luis Creek, Cal.
  Santa Rita Bridge, Cal.
  Settegast, Texas.

Province of Ontario, Department of Mines:
  Map No. 30d—Boston-Skead Gold Area, District of Timiskaming, Ontario.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Which a Market Is Sought.

02–76 Collection of mineral specimens.
02–77 Quartz prospect; four-foot vein, assay $14.00, some copper and silver.
02–78 Quartz prospect; three-foot vein, assay $35.00, free gold.
02–79 Quicksilver property; 200,000 tons blocked out, in Lake County.
02–80 Gold quartz property; patented, small, low price, easy terms.
02–81 Zirconium deposit; 300,000 tons, San Diego County.

Mineral Products or Deposits Wanted.

03–63 White potters clay, and calcined gypsum; carload lots.
03–64 White-burning clays, within radius of 100 miles of Los Angeles and near railroad; deposits.
03–65 Chalcedony, onyx or travertine, preferably pink or red, that will cut to one-inch cubes.
03–66 Quartz crystals; clear; for export.
03–67 Plastic, white-burning clay; deposit or car-lots.
03–68 Asphalt and bituminous sand deposits.
03–69 Granite.
03–70 Abalone shell, sea pearls, gems, emeralds, sapphires; for export.
03–71 Silica sand, within radius of fifty miles of Los Angeles.

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–14 Mining Engineer-Draftsman. Experienced; especially in coal-mining. Single. Age 31. References.

During the month notices of two 'positions open' were received by phone from employers wanting technical help, and registered applicants were at once placed in touch with the opportunities offered.

JUNE, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. TUCKER, Mining Engineer.

Shasta County.

The *Gold Dollar Mining Company* has been incorporated to operate the Gold Dollar Mine, near Shasta. The incorporators are F. A. Zimmerman, J. W. Carter and J. D. Anderson. Considerable development has been done on the property by Zimmerman and Anderson.

The *South Star Mine* has been located in the French Gulch Mining District, in section 32, township 33 north, range 7 west, by Charles Garrett, J. G. Pepper, W. P. Donnelly and W. W. Treat of Anderson.

The *Gladstone Mine*, located at French Gulch, which was being operated by the French Gulch Mining Company of San Francisco, suspended operations the first part of this month.

The Brunswick mill was operated the early part of this month on ore from the *Summit and Brown Bear* mines of the French Gulch District.

The properties are under lease to Borges Bros. of French Gulch.

A pump has been installed at the *West End Mine*, near Whiskeytown in the Shasta Mining District, and the underground workings are being unwatered through a shaft 100 feet deep. There are about 2000 feet of crosscuts and drifts on the property. The shaft and these workings are to be retimbered. Five men are employed.

The property is under bond to the C. D. Jones & Company, of Los Angeles. W. N. Parsons is directing the work.

The construction work on the *Shasta Zinc and Copper Company's* new refining plant at Bully Hill was completed early this month and production of copper matte and zinc oxide commenced on the 12th of June. The plant consists of roasters, storage bins, cooling system, reverberatory furnaces and bag house. The smelter has a capacity of 150 tons of ore per day, producing about 30 tons of zinc oxide per day, with copper matte, containing some gold and silver values, as a by-product.

The zinc-copper-silver-gold ore comes from their Rising Star Mine.

G. T. Jackson is general manager.

Siskiyou County.

R. N. Diggles of Oakland has purchased the lease of the *Gilta Mine* on No-nothing Creek, a tributary of the Salmon River, from H. L. Johnson. The Gilta has a record of having produced over $1,000,000 in gold. There are five claims included in the lease with a water right that furnishes sufficient power for the operation of a sawmill, concentrator and ten-stamp mill.

It is reported that *E. T. Hayes* has discovered a rich lead at Packer's Gulch in the bend of Coffee Creek.

Harvey Bowerman is working on a seam of high grade ore in the *Wild Irishman Mine* on Canyon Mountain.

Trinity County.

The *Strode Mines Company* of Milwaukee, Wisconsin, made the final payment on the Strode Mine situated north of Carrville.

There are eleven mining claims in the group transferred, and a ten-stamp mill. The present company is working two shifts.

James F. Meikel is superintendent.

The *Trinity Bonanza King Mine*, situated nine miles north of Trinity Center, is being operated by the Foster Gold Mining Company of San Francisco. Ten men employed on development.

B. B. Brown of Weaverville has a lease on the *La Grange Hydraulic Mine*. The mine is being operated in a small way. Five men are employed.

The *American-Italian Hydraulic Gold Mining Company* of San Francisco, who have been operating the Paulsen Hydraulic Mine, on the Paulsen ranch, near Lewiston, are suspending operations for the season on account of the shortage of water. Three giants have been operating since the first of March. The water supply is secured from Rush Creek through two ditches, one seven miles in length, and a lower one three miles long.

The bank shows 25 feet of partly cemented gravel overlain by 20 feet of soil overburden. The gravel is drifted and blasted before being piped. When operating, eight men are employed. H. S. Whittard, superintendent.

The Lorenz Bros. of Weaverville, are operating four giants on the *Lorenz Hydraulic Mine* below Weaverville. Two shifts are employed.

Owing to shortage of water, operations will be suspended about July first.

The *Jacobs Hydraulic Mine* near Junction City is being operated by J. O'Shay.

Piping is done with one giant. This property will also have to close this month on account of shortage of water.

The *Pacific Gold Dredging Company*, who have been operating a steel dredge all winter near Carrville, have suspended operations.

It is reported that the large dredge of the *Estabrook Gold Dredging Company* at Trinity Center, which was shut down in 1920, and was not operated in 1921, is to be started in the near future.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

Butte County.

Bader Brothers (Mat Bader) Mine. This old drift mine is in Sec. 36, T. 23 N., R. 3 E., less than a mile west of Magalia on the east side of Little Butte Creek Canyon. E. F. Woodworth of Paradise, began work November 15, 1921, on the property. There are a number of old tunnels, the principal one being reported 800 feet long. It is said to have crossed the channel and to be too high for proper working, although there was some production from it. Woodworth is driving a new tunnel nearby and a few feet lower than the old one. This new work is at an elevation of 1975 feet and to date of visit, June 9th, had reached a length of 150 feet in a direction a little south of east. A flow of about 12 miner's inches of water had just been encountered at the face and the adit was being advanced in soft schistose bedrock. About 10 inches of water was also flowing from the old tunnel. It was estimated that 250 to 300 feet more work will be required to reach the channel. Three men were employed.

Blue Hog Mine. Feather River Land and Mining Company, owner. Paragalia Mining Company, lessee. E. F. Woodworth, manager. Since the 1920 report, not much mining has been done, and the property is idle now. A lawsuit came up between the owner and lessee regarding water. The lessee claimed damages on the ground that lack of water had prevented washing proven gravel after $39,000 had been spent on the mine, and that the right to this water had been held forth as belonging to the mine, but the owners denied this and the lessee lost the decision in the Superior Court.

Butterfly (Morris Ravine, Goodall & Perkins) Drift Mine, three miles northeast of Oroville, has been idle since June, 1920, but some efforts are now being made toward resuming work. The last work was by the Table Mountain Mining Company. Besides extending an old tunnel 400 feet, they sank a double compartment incline 392 feet and drifted 110 feet in all from it, producing $4,000.

Cherokee Mine, near Cherokee and 13 miles from Oroville, has been worked in a small way during the rainy season in late years as a drift mine. An adit has been run 500 feet in the bedrock of the old hydraulic pit, and raises have been put up on both sides. The face of this adit is about under the face of the old hydraulic bank. The raise on the east side is near the face of the adit and is up about 30 feet entering fine free wash quartz gravel with a white sand roof. This gravel has been drifted on east and west 50 feet and is said by David Vinton to yield $2.50 a cubic yard. On the west side of the adit, 250 feet in, a crosscut was run 50 feet and a raise put up a few feet into coarse blue gravel. This layer of gravel carried coarse gold and was the principal producing stratum in the old hydraulic mine. It is partly cemented and lies on a false bedrock of barren wash 10 to 20 feet thick, which in turn rests on the true bedrock.

Vinton estimates that 200 inches of water from a watershed of 16 square miles is available for washing gravel on an average of six months annually. The channel has a total width of 700 to 1000 feet, runs southwest, and if it maintains its grade the present tunnel ought to allow working about 600 feet downstream. Based on results had from his prospecting operations, Vinton states his belief that the property could be drifted profitably for a mile and a half in length and several hundred feet wide, if mined on a large scale through a lower water-grade tunnel.

Highland Chief Mine. Carl A. Phelps of Magalia and M. H. Ballou of Fairfax are just completing construction of a clam-shell dredger on this river claim on the West Branch of North Fork of Feather River in Sec. 30, T. 23 N., R. 4 E., about two miles northeast of Magalia by road and trail. There are 30 acres patented in the mine which is said to cover 1500 feet along the river and Phelps reports that tests made show the gravel to range from a thin layer to 24 feet deep.

It is proposed to first dredge the river bottom, and later some high bench gravel on the west bank, which has been drifted, may also be worked. The bedrock is schist and serpentine and some large boulders occur, but Phelps thinks he can handle these. The barge is of wood, 20 by 30 feet in dimensions and is anchored on two spuds 12 by 12 inches by 24 feet. Power is to be furnished by a 15-horsepower gas engine, geared to lift 8000 pounds on the boom. The clam-shell bucket holds $\frac{3}{4}$ cubic yard, weighs 2500 pounds empty and will weigh about 5000 pounds loaded. The outfit has an estimated capacity of 200 cubic yards for an 8-hour shift, but this does not make allowance for breaking and handling boulders.

Gravel will be screened and washed in a line of 12-inch sluices 500 feet long, with Hungarian riffles. A 3-inch centrifugal pump driven by a 3-horsepower gas engine is to be used to pump water from the river to the sluices.

This section of the stream is said to have never been flumed, and should carry good pay. The use of a clam-shell bucket in such ground is of course experimental, and results will be watched with interest.

Lucky John Mine. John D. Hubbard, Chico, trustee for owners; Enterprise Gold Mining Company, lessee; A. J. Martens, president; G. A. Phillips, superintendent. The mine is in Sec. 11, T. 22 N., R. 3 E., on the east side of Little Butte Creek, about two miles by road and trail from Paradise and contains 320 acres, patented. It adjoins the Mineral Slide Mine on the east.

There is an old tunnel near the west property line which was driven southwest some distance across the line, and it is locally reported that considerable ground was breasted upstream through it. Gravel in this old tunnel was first found in a raise 96 feet high, but as the tunnel went forward, it finally entered gravel.

A new tunnel is being driven southeast, 150 feet vertically above the old one and 350 feet from it on the slope. When visited (June 8) it had reached a length of 566 feet; at 257 feet in, a raise put up by former operators had struck gravel 45 feet vertically above the tunnel and an area about 20 feet square had been mined. Near the face of this tunnel the present company has lately opened gravel for a total length of 100 feet, measured at right angles to the course of tunnel. Work so far shows the rim rising to the northeast and pitching away to the south and west, and it is evident that the gravel body has not yet been bottomed, nor can the exact direction of the flow of the ancient channel (if it be such) yet be stated from the amount of work done. Due to the proximity of this property to the old Neocene shore-line it is perhaps hazardous to theorize much regarding the character of gravel deposits in the immediate vicinity, whether they be channel gravels, delta or bay deposits. This gravel, however, appears to be stream gravel. It is slightly cemented and at the face is distinctly blue in color, being composed of schist and serpentine with little quartz. The bedrock of the district consists of black slate, serpentine and schist. So far the gravel is dry. It is yielding coarse gold in profitable quantity and the small amount of work done indicates the presence of a large body of it. Elevation at the upper tunnel is 1550 feet.

Work is now in progress to bring electric power to the property from the top of the ridge, 2700 feet distant. Water from the tunnels will be conserved in tanks for washing gravel, but this supply will have to be augumented if much work is done. As planned at present, gravel will be dropped down a chute to the lower tunnel level and will be run through a trommel before washing.

Pitts Mine. (*Old Bader, Mowry & Newman*). In sections 1 and 2, T. 22 N., R. 3 E., a mile and a half from Magalia by road and trail. J. M. Pitts et al. of Magalia have a lease and option.

Pitts started work here in December, 1920. He has driven a new adit 600 feet southeast in black slate bedrock to bottom the channel which traverses the property. To date of visit (June 9) the gravel had not been entered, and from surface indications it appears likely that it may lie as much as 100 to 200 feet ahead of the present face and to the eastward. One raise was put up 400 feet in, and another was being put up at the face, but both were in slate all the way, although they have probably been sent up high enough to catch the channel, if it lies above them, unless there has been considerable faulting. The elevation of the new tunnel is 1780 feet and it is 215 feet below the surface at the 600-foot point.

The channel has been mined profitably a short distance northeast of the present work. A good-sized hydraulic pit was opened on the west rim, and the portals of several old tunnels, now caved, are seen in the face of this pit. No. 1 tunnel was driven 2200 feet and is said to have been six feet too high to bottom the channel. The Newman tunnel was run to bottom it, and is said to have produced $200,000 in a few hundred feet; its exact length is unknown. The channel was 60 to 85 feet wide. Three other tunnels were also run nearby. About 1000 feet south of the new tunnel and 115 feet above it an incline was put down 45 feet on the west rim, and showed wash gravel, but was abandoned, presumably on account of water, before reaching the channel trough.

The property is equipped with a 25-horsepower gas engine, 8 x 6 air compressor, blower, air drills and several small buildings.

Besides the placer workings, there is a quartz vein 2 to 5 feet wide crossing the north end of the property and striking southeast. A drift has been run for 300 feet on this vein, and at the face is 100 feet below the surface. Some of the rock from surface pits was crushed years ago in an arrastra.

Steifer Mine. Contains 80 acres patented, in Sec. 12, T. 23 N., R. 3 E., three miles by road from Magalia. P. B. Steifer Mining Company, owner. The Evening Star Mining Company did the last work on the property in 1921 but quit on account of financial troubles, and the mine is now idle (June 10).

The Steifer shaft is about 200 feet from the old Magalia workings and the present face is said to be about 900 feet upstream from the face of the old Magalia drift. The channel is reached by a shaft and incline 508 feet deep. According to a former employee of the last operators, they ran ahead about 400 feet and the drift is said to be three feet above bedrock at the face. When the last company quit, they allowed the men to work the property a short time in an attempt to take out what was due them for wages. One of these men states that they had a breast of gravel at the face 20 feet wide and seven feet high worth $13 a yard in place, but it appears they were unable to make this pay because 20 men were required for surface work, hoists, etc., with only four or five at the working face. The owners and the last operators were not at hand and these figures could not be verified. The bedrock is slate and the gravel is free wash, averaging 2 to 6 feet deep and carrying some platinum. Two hoists have to be operated, one at the incline and one on top. The mine makes about 580 gallons of water a minute, and this is used for washing gravel. The property has its own hydro-electric power plant on the west branch of North Fork of Feather River, and also steam power equipment.

Surcease Mine. The Gruss Mining Company, formerly operators of the Gruss Mine near Genesee in Plumas County, have recently taken machinery to the Surcease Mine on Feather River near Las Plumas, and have begun preliminary work.

Nevada County.

South Star Gold Mines Company. A. W. Johnson, president, 57 Post Street, San Francisco. This property was locally reported to be idle at the time of the last trip to the district, and was not visited. It is located in Rough and Ready District, three miles from Grass Valley.

The president of the company states that since our 1920 report they have continued one shaft to a depth of about 300 feet and have connected it at the 100 level with another old shaft by a drift 240 feet long and 26 feet of crosscuts. Johnson claims they have good milling rock all along the 240 feet of formation, which is the usual white quartz of the district, with occasional specimens. Three or four men are employed.

Placer County.

American Bar Quartz Mine comprises several unpatented claims traversing the center of section 33, T. 14 N., R. 11 E., on the steep north side of the canyon of Middle Fork of American River, three and one-half miles by road and trail from Michigan Bluff and 33 miles from Auburn. The river here flows at an elevation of about 1300 feet. The American Bar Gold Mining Company has done work recently on the claims.

The country rock is Carboniferous slate. Dikes probably of diorite have been intruded into the slate and their strike is about the same as the slate's schistosity but they dip at a small angle to it. The dikes contain much pyrite and weather a rusty red. In the underground workings they are hard and tough.

Numerous adits have been opened at intervals along the slope. The old workings were run 25 to 30 years ago and included an adit about 2000 feet long. A small mill was operated then. At present there is a ten-stamp mill which is designed to run by water power and is located near the river, but it is idle. The later accessible workings visited are as follows:

Adit No. 1, aneroid 1330 feet elevation, is near and just north of the mill. It was run 40 feet north, 20 degrees west. At the portal there is a bunch of quartz giving way to a ribbon formation of quartz and slate, and showing in the face only two or three seams of quartz one-half inch wide, with a gouge an inch wide on the hanging wall. The formation carrying the quartz seems to be bearing off to the northwest to the left of the line of the tunnel.

Northwest of the mill a few hundred feet the rock series is well exposed on the steep hillside. It shows a system of alternating layers of slate, quartz veins and rusty dikes striking north 20 degrees west and dipping northeast. This series has been followed 500 feet or more on the strike by surface prospecting and shows possibilities, with quartz veins from a foot to three feet or more thick.

Adit No. 2 runs north 30 degrees west at 1500 feet elevation and shows at the face two feet of quartz with a dike on the footwall, dipping northeast.

The third adit, elevation 1575 feet, is caved at the portal. The dump is slate and quartz. There are indications that a slide from the hillside occurred here.

The fourth adit is at 1725 feet elevation. It runs 200 feet about north 20 degrees west, showing near the portal a vein of solid quartz two and one-half to three feet wide, which soon gives way to ribbon rock, but there is a fair showing of bunchy quartz at the face. There is a raise up 15 feet on the vein 75 feet back from the face. The ground opened in this adit is rather heavy, black slate.

Adit No. 5, elevation 1780 feet, is the site of present work. This is a crosscut in a wide formation of ribbon rock (quartz and slate) for a short distance and there are drifts both ways on the vein from the crosscut for a total distance of about 100 feet. On the south the drift portal has been walled up and work was progressing north 20 degrees west at time of visit (May 29). This north drift is in good looking ribbon rock, carrying considerable pyrite and traces of galena; 27 feet back from the face the vein is six feet wide and at the north face was two feet wide, with a dike three feet wide on one wall; the vein here stands nearly vertical. There has been old work, including stoping, on and above this level, and a winze, now full of water, below the level.

On the surface above the vein is 12 feet wide, and several hundred feet north it shows 12 to 20 feet wide, accompanied by a wide dike. There is ample room for developing the property at depth through adits.

Centennial Mine on Duncan Hill, three miles west of Auburn, is being reopened by W. D. Chambers, who plans to prospect below the old workings by continuing one of the numerous shafts below the level of former operations. The greatest depth heretofore worked was about 250 feet, but most of the claim has been unexplored below 200 feet in depth.

Among operations recently started may be mentioned the work of the *Independence Mining Company* which has just taken in gas engines and other machinery to reopen some old drift mines near Forest Hill. The *Sacramento* and *Texas* drift claims near Forest Hill are also being rehabilitated by R. A. Nicol and others.

The recent death of *George Carmack*, discoverer of the rich diggings on Bonanza Creek, the finding of which started the Klondike rush, is noted with regret. Some years ago Carmack bought some drift mining prospects in the eastern part of Placer County, and since then has been spending his summers in exploring his property. Carmack endured thirteen years of hardships in the north before making his famous discovery, but when wealth came to him it did not spoil him, and he remained to the end the temperate and unassuming prospector, content to live in a rough log cabin and to do a hard day's work in spite of his wealth. His passing is a loss to the state and to all who knew him.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Opportunities for making field investigations of new development in this district were limited during the month and no important districts were visited. A few days were spent in Glenn County in collecting a number of missing mineral production figures and in visiting a reported strike of rich silver ore near Willows. The balance of the month was taken up with office duties.

Contra Costa County.

The *Pacific Sanitary Manufacturing Company*, recently organized with a capital of $2,000,000, will take over and operate three existing plants in this county, heretofore controlled by officials of the new organization.

These plants comprise an enameled iron works at North Richmond, and two potteries on Barrett Avenue, San Pablo. Plans are under way for extensive additions and improvements in all three plants, to increase the capacity approximately 100 per cent. N. W. Stern is president, and M. E. and E. S. Wangenheim, first and second vice-presidents, respectively. Home office, 67 New Montgomery Street, San Francisco.

Glenn County.

Titanic Mining Company, K. Reynolds, agent. K. Reynolds and D. McLoughlin, of Elk Creek, located fifteen claims for gold, silver, and copper in April of this year, on Atwood Gulch, one-half mile west of the Geo. Gillaspy Ranch. The claims are in T. 21 N., R. 7 W., thirty-three miles westerly from Willows on the Alder Springs road which crosses the property. Fruto, about ten miles distant is the nearest railroad point.

The area in which the claims lie is made up of the Franciscan formation, consisting of altered sandstone, chert, schists and masses of intrusive serpentine; a narrow belt of the latter being crossed just before reaching the property.

A mineralized zone coursing N.E. to S.W., consisting of narrow quartz stringers, associated graphitic schists, and slates, is covered by the claims. Iron pyrite is sparsely disseminated throughout. Hematite was also noted in places. A shaft thirty feet deep, in which considerable values in silver were said to have been found, was half full of water at the time of visit.

The two owners and a third man were just starting an adit on another claim one-quarter mile southwest of the shaft. This is expected to cut a series of narrow stringers at moderate depth.

There is no definite ore body exposed as yet and the chances of developing one do not appear encouraging. Gold, silver, copper, and quicksilver indications have been found in this vicinity in the past, but they have never resulted in the opening up of any important deposits.

LOS ANGELES FIELD DIVISION.

M. A. Newman, Mining Engineer.

The clay industry in southern California is keeping apace with the growth of the state, and is slowly but surely cutting off the competition of the Ohio and other middle west states pottery manufacturers.

The Pacific Clay Products Company, with offices at 600 American Bank Building, Los Angeles, and formerly known as the Pacific Sewer Pipe Company, is manufacturing a varied line of clay products from its several deposits, as follows:

Los Angeles and Riverside Counties.

At present, the company is shipping clay from the Alberhill and the McKnight Pit, three miles southwest of Corona. From the latter, it produces a black flint clay, besides some blue refractory clay. This clay lies on the top and south side of a low hill in a bed dipping south at an angle of 35 degrees, and it is mined both in open cuts and tunnels. The black flint clay varies from 4 to 30 ft. in thickness, overlain by a heavy bed of blue clay, and about 10 to 20 ft. of a reddish variegated plastic clay capped by a coarse granitic sand. This clay is used in the manufacture of fire brick, and ten men are now employed mining it.

About one mile south of the south pit of the Alberhill Coal and Clay Company, and at the southern extremity of the ridge, is located what is known as the Alberhill deposit. This supplies the clay used in the manufacture of sewer pipe and drain tile. This clay is mined from a large open cut which exposes a bed of red mottled clay about 30 feet in thickness. Fifteen men are here employed.

In the Temescal Valley, north of Alberhill and one mile southwest of the Harrington Pit, the company owns another deposit known as the

Hoist Pit clay property. These clays are similar to those of the Alberhill deposit, except that there is an overburden of 5 to 25 feet of sand and boulders. At one side of the pit the sand is underlain by white plastic clay from 15 to 25 feet thick, underlain by a red mottled clay. At the opposite side of the pit the clay rests on red mottled clay, of which a portion has pisolitic structure. Both the red and white clays are smooth and plastic, but in places contain disseminated quartz grains, which prohibits their use in fine ware, unless carefully selected, or coarse particles removed by some method of washing. Fifteen men are employed at this deposit.

PLANTS.

The company operates three plants in Los Angeles County, having closed down or dismantled those it formerly had in Riverside County.

Plant No. 4. In Los Angeles, at 306 West Ave. 26. Used for manufacturing fire brick, face brick, stoneware, and yellow mixing bowls.

The equipment at this plant consists of three dry-pans, two wet-pans, one filter press, one sewer press, one Giant augur, 12-brick wire cutters, two Eagle re-pressers, one Bonnett re-presser, sixteen down-draft kilns, varying in diameter from 20 to 30 feet. Power is supplied by a 250-horsepower boiler, using fuel oil and operating a 200-horsepower engine. 100 men employed.

Plant No. 5. In Los Angeles, at Slauson and McKinley Avenues. This plant manufactures electric conduit, flue lining, gas flues, and fire clay. Plant formerly owned by the California Clay Manufacturing Company. 50 men employed.

Plant No. 6. Located at Los Nietos, 10 miles southeast of Los Angeles, on Santa Fe Railroad. Used mainly for making sewer pipe, and a complete line of gas flues and chimney pipe. 100 men employed.

San Bernardino County.

The *Anaconda Gold Mining Company* has been issued a permit by the Corporation Commission to sell 24,995 shares of stock at $0.50 per share. This company has six unpatented claims in the 29 Palms Mining District, being about 35 miles from the town of Bagdad.

The principal workings consist of an old shaft 185 feet deep, and 185 feet of tunnel work on the Anaconda claim. The ore occurs in small lenses and the company proposes a campaign of development work with the view of opening up ore of a commercial grade which will justify the erection of a milling plant.

RANDSBURG DISTRICT.

The *California Rand Silver, Inc.,* during May reports as follows:

Shipping ore, 858 tons; milling ore, 4150 tons; total advancement for the month, 1572 feet. The smelter returns from 22 cars of shipping ore and four cars flotation concentrates netted $125,012.81. The mill at present is crushing from 125 to 150 tons per day and the company proposes to increase this tonnage to 200 tons per day. The four cars of flotation concentrates shipped during May, amounting to 172 tons, had a gross value of approximately $65,000.

The shipping ore at present comes from the first and seventh levels. On the eighth level in the 806 drift 700 feet east of the main shaft a fine vein of milling ore eight feet wide has been opened up and from the gradual increase in values the management believes that shipping ore will also be developed at this point.

Regular dividend No. 28 for two cents per share, total distribution amounting to $25,600, was declared during the month.

The King Solomon Mine is to be reopened. For the present, work is to be confined to sinking the shaft from the 450 level, together with drifting and crosscutting from this point.

Randsburg Silver Mining Company (Coyote). The advance during May was close to 200 feet of development work and resulted in disclosing two new veins on the fifth level. On the Foster Group, the Foster shaft has reached a depth of 450 feet, and is said to be in the schist formation. The community shaft being sunk by Fox and Barret has reached a depth of 70 feet and hoisting and compressor equipment is now being installed. On the Herkalrath and Carrol lease the shaft is now down 214 feet and has penetrated the mud formation similar to that found in the Kelly mine.

The Grady shaft has gone through the superficial wash and is reported to have penetrated a schist formation. Present depth, 690 feet.

The Mizpah Montana shaft is now down 260 feet. A station has been cut at the 220-foot level and prospecting from this point is being commenced.

The *L. & L. Mining Company* has received a permit to sell 100,000 shares at $0.75 net per share to the company for development purposes.

The property consists of seven claims, known as Midway No. 1 to No. 7, inclusive, which lie on the west side of the Providence Mountains in T. 11 N., R. 13 E., S. B. M., about five miles northeast from the town of Kelso.

The claims are traversed by two veins and it is proposed to run a tunnel to intersect both veins at depth.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

From May 6, 1922, to and including June 10, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well	Field
COLUSA COUNTY:					
Empire Producers Assn.	31	15	4	1	----------
Young Oil Co.	21	14	5	1	----------
FRESNO COUNTY:					
Henry H. Cassriel	20	19	15	1	Coalinga
Salvia Oil Co.	24	20	14	20	Coalinga
KERN COUNTY:					
Belridge Oil Co.	34	30	24	1	Elk Hills
Pacific Oil Co.	35	30	24	2	Elk Hills
Pacific Oil Co.	35	30	24	7	Elk Hills
Pan American Petroleum Co.	1	31	24	5-A	Elk Hills
Pan American Petroleum Co.	2	31	24	3-F	Elk Hills

Company	Sec.	Twp.	Range	Well	Field
KERN COUNTY—Continued.					
Pan American Petroleum Co.	2	31	24	9-F	Elk Hills
Pan American Petroleum Co.	2	31	24	16-F	Elk Hills
Pan American Petroleum Co.	2	31	24	17-F	Elk Hills
Pan American Petroleum Co.	2	31	24	18-F	Elk Hills
Associated Oil Co.	30	28	28	4	Kern River
Associated Oil Co.	30	28	28	3	Kern River
Gray Heirs	3	29	28	40	Kern River
C. H. Holbrook, Jr.	6	29	28	25	Kern River
A. W. Hunt	2	29	28	3	Kern River
A. W. Hunt	2	29	28	4	Kern River
Standard Oil Co.	11	28	27	3	Kern River
Midway McKittrick Oil Co.	29	30	22	2	McKittrick
Associated Oil Co.	34	31	23	43	Midway
C. C. M. O. Co.	22	31	22	19	Midway
Caribou Oil Mining Co.	28	31	23	5	Midway
Combined Oil Co.	14	31	22	34	Midway
Honolulu Cons. Oil Co.	6	32	24	29	Midway
Honolulu Cons. Oil Co.	6	32	24	51	Midway
Honolulu Cons. Oil Co.	4	32	24	9	Midway
Midway Gas Co.	27	31	23	37	Midway
Murvale Oil Co.	26	31	23	M-20	Midway
Pacific Oil Co.	27	31	23	33	Midway
Pacific Oil Co.	15	32	24	21	Midway
Pacific Oil Co.	31	31	24	16	Midway
Pacific Oil Co.	31	31	24	17	Midway
Pacific Oil Co.	7	32	24	37	Midway
Good Roads Oil Co.	12	12	24	15	Sunset
Goldman Oil Synd.	25	29	20	1	Temblor
Porterville Oil Synd.	7	22	27	1	----------
Standard Oil Co.	28	11	20	1	----------
LOS ANGELES COUNTY:					
Apex Petroleum Corp.	19	4	12	1	Long Beach
Apex Petroleum Corp.	29	4	12	2	Long Beach
Bartholomae Oil Synd.	29	4	12	1	Long Beach
R. R. Bush Co.	20	4	12	2	Long Beach
R. R. Bush Co.	19	4	12	1	Long Beach
Calmont Oil Co.	30	4	12	1	Long Beach
Coast States Oil Co.	30	4	12	1	Long Beach
Walter H. Fisher	30	4	12	1	Long Beach
General Petroleum Corp.	20	4	12	2	Long Beach
General Petroleum Corp.	19	4	12	2	Long Beach
Henderson Petroleum Synd.	20	4	12	1	Long Beach
Henderson Petroleum Synd.	30	4	12	1	Long Beach
Interstate Oil Corp.	29	4	12	2	Long Beach
C. O. Jaggers Co.	27	5	11	1	Long Beach
Wm. Keck	29	4	12	Swaffield 1	Long Beach
W. M. Keck	29	4	12	1	Long Beach
The Marine Oil Corp.	29	4	12	3	Long Beach
Oceanic Oil Co.	19	4	12	1	Long Beach
P. M. C. & M. Synd.	29	4	12	1	Long Beach
Parker-Anthony Oil Synd.	29	4	12	1	Long Beach
Progressive Syndicate	19	4	12	1	Long Beach
Shell Co.	29	4	12	1-A	Long Beach
Shell Co.	29	4	12	Lynch 1	Long Beach
Shell Co.	29	4	12	Pickler 2	Long Beach
Shell Co.	19	4	11	1	Long Beach
Shell Co.	29	4	12	1	Long Beach
Shell Co.	29	4	12	Stratton 1	Long Beach
Shell Co.	29	4	12	3	Long Beach
Temescal Oil Co.	20	4	12	1	Long Beach
Temescal Oil Co.	19	4	12	1	Long Beach
Joseph K. Tobin, Lessee	19	4	12	1	Long Beach
Transport Oil Co.	14	4	13	1	Long Beach
Union Oil Co.	30	4	12	4	Long Beach
Wigle-McBride	29	4	12	1	Long Beach
National Cons. Petroleum Co.	28	1	14	4	Salt Lake
Bandini Petroleum Co.	7	3	11	1	Santa Fe Springs
Cooperative Oil Synd. of Santa Fe Springs	6	3	11	1	Santa Fe Springs
J. J. Doyle	6	3	11	1	Santa Fe Springs
E. G. B. Oil Synd.	6	3	11	1	Santa Fe Springs
General Petroleum Corp.	5	3	11	7	Santa Fe Springs
General Petroleum Corp.	5	3	11	69	Santa Fe Springs
Jameson Oil Co.	6	3	11	1	Santa Fe Springs
Jameson Oil Co.	6	3	11	C-W 1	Santa Fe Springs
W. M. Keck	6	3	11	1	Santa Fe Springs

Company	Sec.	Twp.	Range	Well	Field
LOS ANGELES COUNTY—Continued.					
Claude E. McIntyre	6	3	11	1	Santa Fe Springs
McKeon & Parkford	7	3	11	1	Santa Fe Springs
Pacific Petroleum Corp.	6	3	11	1	Santa Fe Springs
Schaff-Noble Synd.	6	3	11	1	Santa Fe Springs
Shell Co.	31	2	11	3	Santa Fe Springs
Standard Oil Co.	5	3	11	3	Santa Fe Springs
Standard Oil Co.	5	3	11	4	Santa Fe Springs
Star Petroleum Co.	6	3	11	1	Santa Fe Springs
Twin Bell Oil Synd.	6	3	11	2	Santa Fe Springs
Union Oil Co.	5	3	11	6	Santa Fe Springs
Union Oil Co.	6	3	11	7	Santa Fe Springs
Union Oil Co.	6	3	11	8	Santa Fe Springs
Western Star Oil Co.	6	3	11	1	Santa Fe Springs
Whittier Santa Fe Springs Oil Synd.	5	3	11	1	Santa Fe Springs
National Cons. Petroleum Co.	22	2	11	4	Whittier
Citizens Oil & Land Corp.	36	7	9	1	----------
Wm. C. Crittenden	4	2	10	1	----------
Golden Gate Oil Co.	23	1	16	1	----------
A. L. Kitselman	22	3	14	2	----------
A. L. Kitselman	23	2	15	2	----------
W. W. Lange	2	2	14	1	----------
Locator's Co.	27	2	14	2	----------
Rock Creek Development Co.	2	5	11	1	----------
St. Helens Petroleum Co., Ltd.	3	2	10	1-B	----------
NAPA COUNTY:					
Associated Oil Co.	29	8	3	29-2	----------
Capell Oil Corp.	15	7	3	1	----------
Griffiths Oil Co.	7	8	3	5	----------
ORANGE COUNTY:					
Fullerton Oil Co.	2	3	10	18	Brea Olinda
Standard Oil Co.	17	3	10	93	Coyote Hills
Blue Shale Oil Mining Assn.	11	6	11	1	Huntington Beach
Bolsa Chica Petroleum Co.	2	6	11	2	Huntington Beach
Holly Oil Co.	35	5	11	3	Huntington Beach
Kiesan Synd.	2	6	11	1	Huntington Beach
Miley Keck Oil Co.	2	6	11	3	Huntington Beach
M. H. Mosier, Special	34	5	11	2	Huntington Beach
Pacific Petroleum Corp.	2	6	11	9	Huntington Beach
Petroleum Midway Co., Ltd.	2	6	11	2-A	Huntington Beach
Republic Petroleum Co.	2	6	11	4	Huntington Beach
Rio Bravo Oil Co.	35	5	11	5	Huntington Beach
Selby, Root & Hogue	34	5	11	2	Huntington Beach
Standard Oil Co.	35	5	11	1	Huntington Beach
Standard Oil Co.	2	6	11	4	Huntington Beach
Standard Oil Co.	11	6	11	1	Huntington Beach
Standard Oil Co.	11	6	11	2	Huntington Beach
Standard Oil Co.	34	5	11	8	Huntington Beach
Standard Oil Co.	3	6	11	19	Huntington Beach
Standard Oil Co.	13	6	11	1-A	Huntington Beach
Standard Oil Co.	34	5	11	18	Huntington Beach
Wellington Oil Co.	2	6	11	2	Huntington Beach
C. C. M. O. Co.	33	3	9	R-4	Richfield
Union Oil Co.	34	3	9	7	Richfield
SAN DIEGO COUNTY:					
Paradise Oil Co.	54	Rode	Nacion	1	----------
San Diego Petroleum Co.	27	16	3	1	----------
SAN LUIS OBISPO COUNTY:					
Mazda Oil Co.	27	31	21	1	----------
TULARE COUNTY:					
Porterville Oil Synd.	7	22	27	1	----------
VENTURA COUNTY:					
Schell & Jennings	32	4	18	1	Piru
Converse Synd. Oil Co.	23	3	21	1	South Mountain
Oak Ridge Oil Co.	13	3	21	8	South Mountain
Oak Ridge Oil Co.	13	3	21	9	South Mountain
General Petroleum Corp.	21	3	23	3	Ventura
General Petroleum Corp.	21	3	23	4	Ventura
Shell Co.	28	3	23	4	Ventura

Drilling is actively concentrated in the new oil fields of the state, whereas development of the older fields has been slowed down and production shut in so as to make way for the high grade flush production of the new fields which, together with small consumption, is forcing large quantities of oil into storage. Fifty per cent of the new drilling reported, since January 1, 1922, has been for the four new fields, as follows: Long Beach, 80 wells; Huntington Beach, 73 wells; Santa Fe Springs, 56 wells; and Elk Hills, 41 wells. The combined production of these fields from the 250 producing wells is about 75,000 barrels daily, which is one-fourth of the present daily consumption of crude and 7000 barrels per day more than the present daily surplus of production over consumption.

Apparently realizing the necessity of bringing about a more equable relationship between production and consumption of petroleum in spite of the overproduction brought about by the rapid drilling of new fields the larger companies have shut in about 26,000 barrels of oil daily. This was accomplished by shutting down 620 producing wells in the older fields of the San Joaquin Valley and Santa Maria District.

Union Oil Company of California, the successful discoverer of the valuable production at Santa Fe Springs oil field, on May 22 shut down over 100 wells, being all but its line wells, on eleven properties in the Santa Maria district. A number of producing wells were also shut down in Coalinga. Shell Company of California, discoverer of Long Beach oil field and with a daily production of about 6000 barrels in that field, has shut down approximately 135 wells in the Coalinga field with an estimated average daily production of 11,000 barrels. Standard Oil Company has about 30 wells shut in in Kern County, representing 4000 barrels daily. Pacific Oil Company has shut in the daily production of 3500 barrels from 170 wells in the Coalinga and Midway fields. General Petroleum Corporation has about 150 wells shut in which normally produce about 2000 barrels of oil daily.

Approximately 2,000,000 barrels of crude oil was run to storage during April, 1922, increasing the state's storage to a total of almost 37,000,000 barrels. Field storage facilities of the state can hold about 78,000,000 barrels of oil. Ninety per cent of these facilities are owned by the three large marketing companies: Associated, Standard and Union Oil. At least 4,000,000 barrels should be deducted from total storage in considering quantities available for the market. This represents the oil which lies below outlets in reservoir and tank bottoms and therefore is not available for the market.

On June 7, 1922, Chanslor-Canfield Midway Oil Company successfully completed its redrilling operations in well No. "Del Amo" 1, Sec. 9, T. 4 S., R. 14 W., S. B. B. and M., and brought in a 1200 barrel well of 23 gravity oil.

While drilling at 3118 feet in October, 1921, the well started flowing gas under a pressure of 700 pounds per square inch. It also showed a small quantity of oil. The 8¼- and 10-inch casing collapsed at this time, however, and the productivity of the Redondo field remained undetermined.

The successful completion of No. "Del Amo" 1 indicates that another oil field comparable with such fields as Long Beach and Huntington Beach has been discovered.

The Redondo oil field is in Los Angeles county at the north end of the Palo Verde Hills near Redondo Beach and town of Torrance.

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

GOLD LODES OF THE EAST FORK MINING DISTRICT, TRINITY COUNTY.

By W. Burling Tucker.

Situation.

The East Fork Mining District is situated in the northern part of Trinity County, on the East Fork of the Trinity river, north of North Fork.

Helena is the postoffice and is the distributing point for this region. The district is 80 miles northwest of Redding, and 33 miles from Weaverville. The district is practically confined to T. 35 N., R. 11 W.

History.

The East Fork Mining District was first discovered in 1884 by Day and Moore, who located the Yellowstone Mine at Coleridge. Day and Leavitt located the Enterprise Mine shortly afterward, which has been operated more or less continuously to date.

Production.

Alaska Mine has a record of	$600,000 00
Enterprise Mine	500,000 00
North Star Mine	200,000 00
Gold Chest Mine	9,000 00
Ozark Mine	60,000 00
Yellowstone Mine	160,000 00

The total production of gold from the district is approximately a million and a half dollars.

Geology.

The formation of the district is mainly granitic gneiss, hornblende schists, mica schists, and serpentine shales, overlying true granite, and the quartz veins seem to be enclosed in the strata between the primary and the metamorphic rocks.

In portions of the district the stratified rocks are much contorted, giving the veins very uncertain courses and dips, being especially noticeable in the Enterprise Mine, where the vein has been disturbed and broken and is resting on the formation as a blanket ledge. The mica of the gneiss and schists is a silvery-white (muscovite), in places the mica entering the quartz schist. In such cases the vein yielded to the granitic rocks and pinched out.

The veins of the district as a rule strike north and south and northwest and southeast, with dips varying from 10 to 70 degrees east. Width of veins varies from six inches to five feet. The ores are usually high in gold values. A considerable proportion of the free gold is coarse enough to be seen and amalgamates readily, but much of it is so fine as to be invisible and can be recovered only by cyanidation. The gold quartz also contains some pyrite, arsenopyrite and telluride.

The oxidized zone is from 30 to 100 feet in depth.

The outcrops of the district are in part prominent, but as a rule inconspicuous.

Timber and Water.

The mountain slopes of the district are clothed with a magnificent stand of pine and fir.

There is an abundant amount of water throughout the year; sufficient to furnish power for operating the mills, and small lighting plants.

Mines.

Alaska Mine, in Sec. 14, T. 35 N., R. 11 W., 10 miles northeast of North Fork, comprises 40 acres, at an elevation of 3100 feet; ore shoot 340 feet long and two and one-half feet wide between slate walls. Development—560-foot tunnel and 1500 feet of drifts. The property is said to have produced $600,000.

Bonanza Group of Mines, 11 miles northeast of North Fork by trail, in Trinity Reserve. Owner, J. L. Johnston. Comprises five claims, 100 acres, in Sec. 10, T. 35 N., R. 11 W. Two parallel veins which strike N. 15° E., and dip 70° east, have been developed on the Bonanza claim. Veins are from 12 inches to three feet in width. The east vein has been developed by two tunnels on north slope of ridge. The upper tunnel, about 25 feet below the outcrop, is 90 feet long, the vein having an average width of three feet of quartz.

About 20 feet below this level a tunnel has been driven south on the vein a distance of 135 feet.

The main working tunnel is on the southwest slope of the ridge. Here, at an elevation of 3625 feet, a crosscut tunnel is driven 60 feet northeast, cutting the vein, with drift 400 feet on the vein. On this level two shoots of ore have been developed, one 40 feet in length, the other 50 feet long; width of vein 12 inches to three feet. The quartz shows free gold, associated with iron pyrite, also some tellurium is present. At 115 feet below this tunnel, a crosscut tunnel has been driven N. 60° E., 300 feet to vein, with drift on the vein 35 feet north.

The Bonanza vein outcrop can be traced for 800 feet on surface. The hanging wall of this vein is composed of hornblende schists, and the footwall is a diorite porphyry. The west vein has been developed by a 75-foot tunnel on the north slope of the ridge. Vein averages 12 inches in width and is said to carry high values in gold. Ore milled from the different workings yielded $8 to $12 per ton. Owner developing property.

Enterprise Mine, in Secs. 4 and 5, T. 35 N., R. 11 W., 7½ miles north of North Fork, in Trinity Forest Reserve. Owner, Enterprise Gold Mining Company of Boston, Massachusetts. Geo. S. Fenwick, secretary. Comprises 160 acres; the first claim, Lone Jack, was located in 1884, and the mine has been operated more or less continuously ever since.

The property is at present under lease to W. R. Biglow of Weaverville.

The Enterprise vein has been developed by several tunnels, one being 1400 feet long; and 3000 feet of drifts and crosscuts. Greatest vertical depth below outcrop is 500 feet.

Three pay shoots of ore have been developed, 900, 300 and 300 feet in length, with an average width of 14 inches; the vein strikes northeast and southwest; dip from 10 to 40 degrees northwest, diorite walls.

Equipment—Machine drills, compressor plant, small electric plant, 10-stamp mill run by water power. Twelve men employed. Production to date $500,000.

Golden Chest Mine in Sec. 9, T. 35 N., R. 11 W., 10 miles northeast of North Fork. Comprises two claims: Golden Chest, Ida Elmore. Henry Behrman and John Boise of Weaverville, owners. Vein strikes N. and S., dip 70 degrees east. Width 12 inches to four feet. Elevation 3000 feet.

Development—Two tunnels, upper tunnel 160 feet, lower tunnel 300 feet. Five-stamp mill, on East Branch of the East Fork. Production $9,000. Idle.

North Star Mine in Sec. 32, T. 35 N., R. 11 W., eight miles north of North Fork, in Trinity Forest Reserve. Owner, North Fork Mining Company. Comprises 160 acres, located in 1884. Eight veins in all, being an extension of the Enterprise lode, strike northwest and southeast, dip S. 30° W.; length of ore shoot 300 feet, width of vein 4 feet. Walls are quartz porphyry. A 950-foot tunnel, drifts and stopes comprise several hundred feet of development work; greatest depth below outcrop 400 feet. Ten-stamp mill. Said to have produced $200,000. Idle at present.

Ozark Mine in Secs. 4 and 9, T. 34 N., R. 11 W., 5 miles north of North Fork. Owner, R. G. Reid. Comprises 40 acres. Development—tunnel 420 feet, 500 feet of drifts. Width of vein two feet. In slate-ore, shoots were short. Ore free-milling and high grade. Produced about $60,000. Idle.

Yellow Aster Mine in Secs. 29 and 21, T. 35 N., R. 11 W., 9 miles northeast of North Fork. Owner, East Fork Developing Company. Comprises 40 acres, located in 1905. Two tunnels, 135 and 170 feet, also 45-foot shaft. Ore free-milling and good grade. Walls are dolomite, and hornblende schists; fissure vein. Idle.

The Yellowstone Mine in Sec. 32, T. 35 N., R. 11 W., eight miles north of North Fork. Comprises eight claims. The main veins are

North Star and Yellowstone. The former is four feet wide, and courses north and south, dips about 45 degrees west, between granite and greenstone walls. Developments consist of crosscut tunnel 400 feet long with drift south on the Yellowstone vein 200 feet, with an upraise to surface. There are four tunnels on the property but all were caved at present writing. One man is driving a new tunnel.

Yellow Jacket Mine in Sec. 10, T. 23 N., R. 11 W., 10 miles northeast of North Fork. Development consists of two tunnels, 100 feet and 260 feet. Pocket mine. Idle.

PROPOSED METHOD OF MINING OIL SANDS

And the Recovery of Oil Therefrom by Flotation Methods.

By M. A. Newman.

These notes are presented in the hope of being of interest to the public, as showing the possibilities of the saturated oil sands of California. The data were obtained from the officials of the California Oil Mining Corporation. The experimental tests were made by the Southwestern Engineering Company of Los Angeles, and the analytical work by the Smith Emery Company. On the results obtained so far, the company feels encouraged to erect a 300-ton flotation plant to test in a large way the merits of this oil sand deposit and if this proves commercially successful, to enlarge same to a 1000-ton per day capacity.

Whenever reference is made to oil sand in California, many otherwise well informed persons have in mind the oil shale about which so much has been written as constituting the world's ultimate oil supply.

Some of California's largest operating oil companies have secured control of thousands of acres of oil shale ground in Colorado, Utah, Nevada, and elsewhere, located in almost inaccessible mountains, miles away from transportation. Many highly trained scientists are devoting their energies to the working out of an economical and practical method for the recovery of the oil from these shales. So far, their efforts have been without marked success.

Here in California, lying along main line railways, paved state highways, near refineries, and in some instances with oil pipe line and fuel gas line at hand, are found large deposits of saturated oil or tar sands, equal or exceeding in oil content the richest of oil shales.

One of these oil sand deposits is under lease to the California Oil Mining Corporation, a Maryland corporation, located about five miles south from San Luis Obispo, California, the property consisting of about 500 acres. For more than six months, this company has been doing development work, driving tunnels, sinking pits and otherwise proving the extent of the deposit, as well as conducting tests to determine the most practical way to save the oil.

Nearly twenty years ago a company engaged in the manufacture of asphalt paving blocks did considerable mining on portions of the property located in what is called North Canyon. Using material for this purpose, they were obliged to confine their mining activities to the face of the outcropping sands. Owing to the high degree of saturation, the mining was confined to shallow openings or workings not more than thirty feet back from the face. Tradition has it that a shipload of paving blocks, upon reaching the harbor at San Francisco, had become so soft that it was necessary to mine them to get them out of the hold. It is evident that those who then worked this sand failed to realize the extent of the volatile oil therein contained.

This property has an enormous body of Pismo sand lying on the Monterey formation dipping about thirty degrees to the southwest, under the Fernando. Over the greater portion of this lease, generally speaking, between the North and South Canyons, the Fernando has been entirely eroded, leaving the Pismo or oil sand exposed without overburden, over an area one-half mile wide north and south and nearly a mile east and west. The main body appears to be several hundred feet thick. Interbedded with the Monterey, under the main body of Pismo, are thinner but heavily saturated strata of sand. These conditions are in evidence in the North Canyon, where all the mining seems to have been done by those who formerly worked the deposit for asphalt. The same characteristics of formation seem to exist on top of the main deposit of Pismo where it finally dips under the Fernando in the South Canyon. Here, however, the outcrop of the interbedded sands does not show the same degree of saturation as in the North Canyon. However, where the creek cuts through the more impervious strata of Fernando considerable seepage is in evidence. It is estimated that there is an enormous tonnage of saturated sand easily accessible in the main deposit of this property, and tests made on samples from this deposit indicate a yield of as much as a barrel per ton of oil sand.

It is proposed to open up the South Canyon deposit first, at a point having an elevation of 825 feet above sea level. Steam shovels are to be used in mining and, when necessary, steam points are also to be used.

The flotation plant, designed by the Southwestern Engineering Company, is to be erected on the low side of South Canyon, at an elevation of 325 feet above sea level, and but a short distance from the oil sand deposit.

The sand is to be washed through a ground sluice to the plant where it first goes through a double screw log washer. From the log washer it passes through a Cottrel Vibrating Screen, which will remove any small gravel estimated to be about two per cent of the material treated. From the vibrating screen the sand passes through three K. & K. mixers in parallel. These are ten feet long by 26 inches in diameter. From the mixers the material flows to eight K. & K. flotation machines used as roughers. These are also 10 feet long by 26 inches in diameter. From the roughers the flotation oil concentrate is sent to four K. & K. flotation cleaning machines 10 feet long by 26 inches in diameter. From these cleaners the oil concentrate goes to two additional K. & K. cleaners and then to a 24-foot by 10-foot Dorr Thickener. From the Dorr Thickener the concentrate is sent to a dewatering and storage tank. The oil here obtained is to go to a small refinery and current practice methods of refining are to be used to recover the various oil products and asphalt.

The following is an analysis of a sample from one of the tunnel workings, made by Smith Emery Company:

Analysis of Test on Tunnel Sample No. 6.

Oil Sands (heads to flotation machine)—	
Total mineral oil by extraction	13.15%
Water	2.50%
Determinations, Oil—	
Light oils, below 550° F.	4.00%
Asphalt	96.00%
Light oils, 23.5° Baumé gravity, recovered by a cracking distillation of the asphalt	73.00%
Tails (72% by weight), flotation tails—	
Oil	0.54%

A solvent such as distillate, tops, or 27 plus oil is to be introduced at the log washer. In amount this is to be equal to about 50% of the estimated oil content of the sand. The amount, however, will vary according to the asphalt content. The loss of solvent will be very small, as the total oil loss in the tails is but .54%, the bulk of the solvent being recovered in the refinery and used over again. It was found that hot water aided considerably and a small amount is to be introduced at the log washer.

The total cost per ton of oil sand treated is estimated at 60 cents, 25 cents for mining and 35 cents for treatment, up to the point of refining.

Obviously, the success of this enterprise is mainly dependent on the average oil content per ton of sand in the deposit to be exploited, as the costs of mining, flotation and refining should be susceptible of estimation to within close limits by competent engineers, who are specialists in these various branches.

CALIFORNIA MINERALS EXHIBITED DURING SHRINE CONVENTION.

By Walter W. Bradley.

A California Products Exhibition was maintained in the Exposition Auditorium, San Francisco, during the week of June 12–17, for the attraction and information of visitors to the convention of the Ancient Arabic Order of Nobles of the Mystic Shrine. It was an excellent advertisement and object lesson of California's resources and products, to the many thousands of visitors from all over the United States who thronged into San Francisco during that week.

Representing California's mineral resources, the State Mining Bureau was allotted a generous floor space in one of the most prominent positions. As the State Mining Bureau lacked sufficient funds to finance the undertaking, this was made possible through the courtesy of the Shrine Committee who urged our participation and guaranteed the transportation and other charges incident to the installation. Especial thanks are due Mr. Albert S. Samuels, chairman of the committee, and Mr. Norman H. Sloan of the California Development Association, for their cooperation in making possible this exhibit. We wish also to thank the several companies, individuals, and county boards of

State Mining Bureau Exhibit, at Exposition Auditorium, San Francisco, June 12–17, 1922.

supervisors for their courtesy in lending the specimens and other exhibit material enumerated below.

The two outstanding features of the exhibit were the safe containing gold specimens of approximately $30,000 bullion value, and the gold dredge model. Prominent among the gold specimens shown was the famous Siskiyou County collection, loaned by the Siskiyou Board of Supervisors, and which has taken prizes at a number of fairs and expositions. This contains a fine group of nuggets (one of which is valued at $550), both fine and coarse placer gold,. leaf and crystallized lode specimens, and quartz well speckled with the yellow metal. Small grains of placer gold from the Milne Mine at Scott Bar on the Scott River, Siskiyou County, were grouped to form the letters of the word 'Siskiyou.' Small-grain placer gold from the Ludekin hydraulic mine, near Volcano, Amador County, and loaned by Mr. J. W. Preston, Jr., manager of the Winship Estate, was grouped to spell 'Amador.' Mr. Preston also loaned a 51-ounce sample of small-nugget placer gold from the Elephant hydraulic mine at Volcano, Amador County.

Included in the material loaned by the Placer County Board of Supervisors were five pieces of crystallized pocket gold recently purchased for $3,500 by the County from the operators of the Garbe and De Maria mine near Michigan Bluff, Placer County. This was their first public appearance in an exhibition, and they were the subject of much favorable comment. The supervisors are to be congratulated on their foresight in buying these specimens for county exhibit purposes, and thus keeping them from the melting pot. One piece is beautifully crystallized and particularly attractive.

Among the other gold specimens shown in the safe, mention should be made of the following: Crystallized gold in quartz from the Ham & Birney Mine, loaned by Mr. H. H. Sherrard, manager of the Tuolumne County exhibit; free gold in quartz from the North Star Mine, Grass Valley, Nevada County, loaned by the company; a beautiful, crystallized specimen, having roughly an outline resembling a California bear, from the Georgia Hill Mine, Yankee Jim's, Placer County, loaned by Mr. Orman Lutz; crystallized and placer gold from Walsh Bros., Auburn, Placer County; crystallized and leaf gold in quartz, from Quartz Hill, Siskiyou County, loaned by Mr. Geo. C. Noonan; free gold on quartz from the Reid mine, Shasta County, loaned by Mr. B. L. Smith; crystallized gold in quartz from the Sheep Ranch Mine, Calaveras County, loaned by Mr. H. R. Plate; massive gold on a quartz boulder from the Table Rock placer mine, Sierra County, loaned by Mr. D. W. Shanks; also several specimens from the collection in the State Mining Bureau Museum, including crystallized gold from El Dorado, Mariposa, Nevada, Shasta and Trinity counties, a platinum nugget and platinum grains from Trinity County, and an uncut diamond from Cherokee Flat, Butte County.

A painting of James W. Marshall, discoverer of gold in California in 1848, was placed on top of the safe. Facsimiles of a number of California's famous gold nuggets, and facsimile gold bars from the Malakoff hydraulic mine and the Carson Hill mine, were shown in a glass case at the front of the exhibit.

The model gold dredge was loaned by the Yuba Manufacturing Company, and is one of the two working models built by that company for the Panama-Pacific International Exposition in 1915. It is built exactly to scale, and represents one of their 18-cubic-foot bucket boats capable of handling 15,000 cubic yards of gravel per day, several of which are operating in the Marysville district, Yuba County. This model elicited quite as many questions and comments as did the gold exhibit.

Among the structural materials exhibited was a beautifully carved and polished granite vase and plaque, loaned by Mr. Walter Ghetti of the Western Granite Company, San Jose. It is made of the 'silver gray' granite from the Lakeside quarry in San Diego County, now operated by the McGilvray-Raymond Granite Company, and is one of the finest pieces of work of its kind that we have ever seen. This stone is of even, uniform grain and color, and especially adapted to monumental work.

Six glass show cases were filled with specimens of ores and minerals, both metallic and nonmetallic, representing the more than fifty different varieties produced by California commercially. The glass show cases were loaned to the State Mining Bureau through the courtesy of the California Academy of Sciences. The petroleum industry was represented by charts showing the relative production of the several states in 1921, and other data such as: number of wells annually, yield per day, and amount of oil in storage.

The exhibit, both collectively and its individual units, received a great deal of attention and much favorable comment. The amount, variety, and quality of California's mineral resources were continuously the subject of expressed surprise and wonderment.

Following the close of the Shrine Convention, the safe with its gold display was placed on exhibition at the American National Bank for a couple of weeks, in order that the business men of San Francisco might have the privilege of viewing those beautiful products of Nature's laboratory, and that they might know that gold mining is NOT dead in California.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coördination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Oil Field Map No. 7, Sunset Oil Field. Revised to May 1, 1922.
Oil Field Map No. 13, Kern River Oil Field. Revised to May 25, 1922.
Oil Field Map No. 14, Coalinga Oil Field. Revised to May 15, 1922.
Oil Field Map No. 15, Elk Hills Oil Field. Revised to June 1, 1922.
Oil Field Map No. 26, Huntington Beach Oil Field. Revised to May 20, 1922.
Summary of Operations, California Oil Fields, March, 1922, Vol. 7, No. 9.
Mining in California, May, 1922, (Monthly) Vol. 18, No. 5.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XVII, State Mineralogist	3
Mines and Mineral Resources of Colusa, etc.	1
Mines and Mineral Resources of Del Norte, etc.	6
Mines and Mineral Resources of Imperial, etc.	2
Mines and Mineral Resources of Butte, etc.	3
Mines and Mineral Resources of El Dorado, etc.	3
Mines and Mineral Resources of Monterey, etc.	3
Mines and Mineral Resources of San Bernardino, etc.	3

Publications	Number distributed
Mines and Mineral Resources of Nevada County	3
Mines and Mineral Resources of Plumas County	6
Mines and Mineral Resources of Sierra County	5
Bulletin No. 6, California Gold Mill Practices	3
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	4
Bulletin No. 72, Geologic Formations of California	17
Bulletin No. 76, Mining Laws, United States and California	50
Bulletin No. 78, Quicksilver Resources of California	9
Bulletin No. 85, Platinum Resources of California	7
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	125
Bulletin No. 90, California Mineral Production for 1920	50
Preliminary Report No. 8, Review of Mining in California during 1921	70
Mining in California, (Monthly) Vol. 19, No. 4, April	2300
County Maps and Registers of Mines	10
El Dorado Forest Map	1
Madera Forest Map	2
Placer Forest Maps	3
Shasta Forest Map	1
Sierra Forest Map	3
Siskiyou Forest Map	1
Copper Deposits Map	1
Tuolumne Mineral Map	1
Geological Map of California, mounted	21
Colored Map Accompanying Bulletin No. 89	37
Oil Field Maps	512

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 735 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

California produces commercially at least fifty different mineral substances, with a total annual value of nearly $250,000,000. There are several thousand operating properties, including mines, quarries, oil and gas wells, mineral springs, gravel pits, mills, and smelters.

Some data relative to 1921 production were given in the April and May issues of 'Mining in California,' and additional substances are covered herein. As we still lack reports from a few operators it is not yet possible to compile complete figures for last year, though nearly six months have now elapsed since its close. We would respectfully urge promptness upon all those interested in the development of California's mineral resources, to the end that production figures may be published at an earlier date. Statistics lose much of their value if late.

BORAX.

Bibliography: State Mineralogist Reports III, X, XII, XIII, XIV, XV, XVII. Bulletins 24, 67.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake, in Lake County, was discovered in September of the same year by Dr. John A. Veatch. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. This was the first commercial output of this salt in the United States, and California is still today the only American producer of borax.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County. These have since been worked out, and the output for a number of years has been coming from similar beds in Inyo and Los Angeles counties. In 1920 San Bernardino County again entered the field with shipments of such ore from near Daggett. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities.

During 1921 there was reported a total output of 50,136 tons, valued at $1,096,326, compared with 127,065 tons, valued at $2,794,206 in 1920. As in 1919–1920, this also includes some refined borax made from the brine of Searles Lake, in San Bernardino County. The considerable decrease from the 1920 figures is due to the lower prices prevailing during 1921.

Colemanite is a calcium borate, and the material mined is mostly shipped to eastern chemical plants for refining. Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steel-ware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats.

Total Production of Borax in California.

The total production of borax in California is shown in the following table:

Year	Tons	Value
1864	12	$9,478
1865	126	94,099
1866	201	132,538
1867	220	156,137
1868	32	22,384
1869	----------	----------
1870	----------	----------
1871	----------	----------
1872	140	89,600
1873	515	255,440
1874	915	259,427
1875	1,168	289,080
1876	1,437	312,537
1877	993	193,705
1878	373	66,257
1879	364	65,443
1880	609	149,245
1881	690	189,750
1882	732	201,300
1883	900	265,500
1884	1,019	198,705
1885	942	155,430
1886	1,285	173,475
1887	1,015	116,689
1888	1,405	196,636
1889	965	145,473
1890	3,201	480,152
1891	4,267	640,000
1892	5,525	838,787
1893	3,955	593,292
1894	5,770	$807,807
1895	5,959	595,900
1896	6,754	675,400
1897	8,000	1,080,000
1898	8,300	1,153,000
1899	20,357	1,139,882
1900	25,837	1,013,251
1901	22,221	982,380
1902	[a]17,202	2,234,994
1903	34,430	661,400
1904	45,647	698,810
1905	46,334	1,019,158
1906	58,173	1,182,410
1907	53,413	1,200,913
1908	22,200	1,117,000
1909	16,628	1,163,960
1910	16,828	1,177,960
1911	50,945	1,456,672
1912	42,135	1,122,713
1913	58,051	1,491,530
1914	62,500	1,483,500
1915	67,004	1,663,521
1916	103,523	2,409,375
1917	109,944	2,561,958
1918	88,772	1,867,908
1919	66,791	1,717,192
1920	127,065	2,794,206
1921	50,136	1,096,326
	1,273,925	$43,859,685

[a] Refined borax.

CEMENT.

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII. Bulletin 38.

Cement is the most important single structural material in the output of the state. During 1921, there was produced a total of 7,404,221 barrels, valued at $18,072,120, a new high record for California, being an increase both in quantity and value over the record figures of 1920. As in the preceding year, the output came from nine operating plants in seven counties. The average value, reported, increased from $2.23 per barrel in 1920, to $2.44 in 1921.

Concrete state highway bridge over Pit River, near Kennett, Shasta County, California. This reinforced concrete arch span is the longest in the state—242 feet. Photo by courtesy of Standard Oil Bulletin.

The cement industry is so distributed in California that it is not possible to apportion the details of production to the counties in which the plants are located without making private business public. With the exception of San Bernardino, no county has more than one cement plant. The three operating plants in San Bernardino County, in 1921, made a total of 1,964,926 barrels of cement, valued at $4,633,437; the balance coming from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, Santa Cruz and Solano.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco. The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield in 1920–1921 exceeded the value of the gold output in both those years.

According to reports of the U. S. Geological Survey, California ranked third as a cement producer in 1920, being surpassed by Pennsylvania with 28,365,000 barrels, and Indiana with 10,700,000 barrels. The 1921 data are not yet at hand.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1907	1,613,563	$2,585,577
1892	5,000	15,000	1908	1,629,615	2,359,692
1893	----------	----------	1909	3,779,205	4,969,437
1894	8,000	21,600	1910	5,453,193	7,485,715
1895	16,383	32,556	1911	6,371,369	9,085,625
1896	9,500	28,250	1912	6,198,634	6,074,661
1897	18,000	66,000	1913	6,167,806	7,743,024
1898	50,000	150,000	1914	5,109,218	6,558,148
1899	60,000	180,000	1915	4,918,275	6,044,950
1900	52,000	121,000	1916	5,299,507	6,210,293
1901	71,800	159,842	1917	5,790,734	7,544,282
1902	171,000	423,600	1918	4,772,921	7,969,909
1903	640,868	968,727	1919	4,645,289	8,591,990
1904	969,538	1,539,807	1920	6,709,160	14,962,945
1905	1,265,553	1,791,916	1921	7,404,221	18,072,120
1906	1,286,000	1,941,250	Totals	80,491,352	$123,712,916

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII. Bulletins 38, 76. Preliminary Report 3, U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 312 short tons of all grades (or 347 tons, recalculated to a basis of 45% Cr_2O_3), valued at $6,870 f.o.b. shipping point was sold in California during the year 1921. There were but three producers who reported sales last year, compared with the high mark of 236 in 1918, since which year the number has steadily decreased, owing to importations of foreign ore which can be landed at the consuming centers cheaper. The ore shipped in 1921 analyzed from 43% to 56% Cr_2O_3, and brought from $15 to $25 per ton. The principal production was in San Luis Obispo County and was utilized by the U. S. Refractories Company in the manufacture of chrome fire-brick. There was also a small output from Placer and Siskiyou counties.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proven to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons was shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promised well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production came from this source.

Economic Conditions.

Chromite is one of several of California's minerals most affected by the economic conditions brought about by the European war. The major portion of our domestic requirements for chrome is for consumption in the steel mills of the East. Formerly, most of that used was imported from Rhodesia and New Caledonia, and they are still, with the addition of India, the more important sources. The reports of the U. S. Department of Commerce show the foreign imports of chromic iron for the eight years 1913–1921, inclusive, to have been 49,772; 75,455; 115,886; 72,063; 100,142; 61,404; 150,275 and 81,836 long tons, respectively. The average price of imports in 1921 was $8.00 per ton.

The major consumption of chromic ore is for its use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferro-chrome for chrome-steel alloys.

Some of the California product in 1916–1918 was converted into ferrochrome in the electric furnaces of the Noble Electric Steel Company at Heroult, California, and some of it was similarly reduced in electric furnaces at Niagara Falls, New York. A small amount of high-grade ore was utilized in preparation of chromates for tanning.

The War Mineral Relief Commission is still working on the adjustment of claims for chromite mined in 1917–1918, an amendment to the Dent Bill having been passed by Congress in November, 1921.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874–1886 (San Luis Obispo Co.)	26,028	$329,924	1904	123	$1,845
1887	3,000	40,000	1905	40	600
1888	1,500	20,000	1906	317	2,859
1889	2,000	30,000	1907	302	6,040
1890	3,599	53,985	1908	350	6,195
1891	1,372	20,580	1909	436	5,309
1892	1,500	22,500	1910	749	9,707
1893	3,319	49,785	1911	935	14,197
1894	3,680	39,980	1912	1,270	11,260
1895	1,740	16,795	1913	1,180	12,700
1896	786	7,775	1914	1,517	9,434
1897			1915	3,725	38,044
1898			1916	48,943	717,244
1899			1917	52,379	1,130,298
1900	140	1,400	1918	73,955	3,649,497
1901	130	1,950	1919	*4,314	97,164
1902	315	4,725	1920	1,770	43,031
1903	150	2,250	1921	347	6,870
			Totals	241,911	$6,404,493

*Recalculated to 45 per cent Cr_2O_3, beginning with 1919.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, approximately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

Among the specimens received recently, and catalogued for the Museum, are the following:

19654. *Dumortierite* (a basic aluminum silicate). From Palo Verde Mountains, Riverside Couny, by M. M. Larsen, Colton, Cal.

19656. *Calcite.* A change by paramorphism of Aragonite to Calcite. Calcite with a pseudohexagonal form of aragonite; the result of repeated twinning. Also penetration twins. From New Mexico, by Henry E. Wood, Lewistown, Montana.

19657. *Gold* (Au). Crystallized arborescent form in 'clay' or gouge material. From Mustang Extension Mine, Manhattan, Nevada, by A. E. Smith, Sacramento, Cal.

19658. *Phyllite* or *Hydro-Mica Schist.* Mainly aluminum silicate and silica with sericite (fine white mica). From 25 miles northeast of Bishop, Inyo County, Cal., by W. P. Yaney, Bishop.

During the month a total of 487 visitors signed their names on the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

A total of 317 samples were received and determined during the thirty-day period covered by this report, indicating that a healthy interest will probably be taken in prospecting during the summer months.

Samples submitted were of great variety, ranging from rare-earth metals to phosphate rock. The available supply of the latter, however, is limited for the present, being a fragment of rock that was blown out of an oil well in Kings County, from a depth of 500 feet. The mineral is a hydrous phosphate of lime and iron, apparently calcioferrite.

A list of those of possible value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–173 Vanadinite (lead-silver ore).
05–174 Kalinite (potash alum).
05–175 Clay; burns white.
05–176 Manganese oxide.
05–177 Talc; foliated.
05–178 Black sand; contains platinum group metals.
05–179 Quartz; some lead carbonate present.
05–180 Jet.
05–181 Asbolite (hydrated oxide of manganese and cobalt).
05–182 Feldspar.
05–183 Ulexite.
05–184 Copper ore; good grade, some silver and gold present.
05–185 Mirabilite (sodium sulphate).
05–186 Uranium phosphate (slightly radioactive); also red oxide of iron (paint pigment).
05–187 Halotrichite (an iron-aluminum alum).
05–188 Phyllite or hydro-mica schist.
05–189 Iron Oxide (red ochre), a paint pigment.
05–190 Quartz with copper and some gold and silver.

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geol. Survey Water Supply Paper No. 477. Surface Water Supply of the United States, 1918, Part VII; Lower Mississippi River Basin. By Nathan C. Grover, Robert Follansbee and Rodger C. Rice.

U. S. Geol. Survey Mineral Resources:
  Fuel Briquets in 1921. By W. F. McKenney.
  Chromite in 1921. By Edward Sampson.
  Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1921. By J. P. Dunlop.

U. S. Bureau of Mines Reports of Investigations:
  Serial No. 2341—Smokeless Fuel for Salt Lake City. By G. St. J. Perrott (Associate Physical Chemist, United States Bureau of Mines), and H. W. Clark (Chief Deputy Smoke Inspector, Salt Lake City).
  Serial No. 2342—Survey of Pacific Coast Petroleum Products. By Earl C. Lane (Assistant Chemist, United States Bureau of Mines).
  Serial No. 2343—Bibliography of Articles relating to the Preservation of Mine Timber. By R. R. Horner (Mining Engineer).
  Serial No. 2344—Recovery of Gasoline from Uncondensed Still Vapors. By D. B. Dow (Petroleum Engineer, United States Bureau of Mines).
  Serial No. 2345—The Economic Relation of Accidents and Preventable Diseases to the Coal-Mining Industry. By Arthur L. Murray (Surgeon, United States Bureau of Mines).
  Serial No. 2346—Acetylene as a Precipitant for Cyanide Solutions. By John Gross (Metallurgist, United States Bureau of Mines).

Serial No. 2347—Garnet. By Raymond B. Ladoo (Mineral Technologist, United States Bureau of Mines).

Serial No. 2348—Recent Articles on Petroleum and Allied Substances. Compiled by E. H. Burroughs (Bibliographer, United States Bureau of Mines).

Serial No. 2349—Fatalities at Coal Mines in March, 1922. By W. W. Adams (Statistician, United States Bureau of Mines).

U. S. Coast and Geodetic Survey:

Serial No. 165—Special Publication No. 74. Utah. Washington Arc of Precise Triangulation. By V. Hodgson (Assistant Chief, Division of Geology).

U. S. Bureau of Standards, Technologic Papers:

Bulletin No. 207—Manufacture and Properties of Steel Plates Containing Zirconium and Other Elements. By George K. Burgess (Physicist), and Raymond W. Woodward (Physicist).

Bulletin No. 208—Weighing by Substitution. By C. A. Briggs (Associate Physicist) and E. D. Gordon (Associate Physicist).

Kentucky Geological Survey:

Conservation of Natural Gas in Kentucky. By Willard Rouse Jillson.

Michigan Geological and Biological Survey; Bulletin No. 31—Biological Series 6, Miscellaneous Papers on the Botany of Michigan. By C. K. Dodge.

Geological Survey of Ohio; Bulletin No. 24, Fourth Series, Geology of Wayne County. By G. W. Conrey.

Bulletin No. 23—Fourth Series, Geology of Camp Sherman Quadrangle. By J. E. Hyde, Bureau of Topographic and Geological Survey, Commonwealth of Pennsylvania.

Bulletin No. 6—River and Creek Coal in Eastern Pennsylvania. By C. W. Webbert.

Bulletin No. 9—Future Use of Raw Coal. By George H. Ashley.

Bulletin No. 38—Coal Beds in Armstrong County, Pennsylvania. By J. D. Sisler.

Bulletin No. 39—Coal Reserves in Armstrong County, Pennsylvania. By John F. Reese.

Bulletin No. 40—White Clay Deposits at Saylorsburg, Munroe County, Pennsylvania. By Frederick B. Peck.

Bulletin No. 42—Coal Beds in Jefferson County, Pennsylvania. By J. D. Sisler.

Bulletin No. 10—South Dakota Geological and Natural History Survey. The Possibilities of Oil in South Dakota. By Roy A. Wilson.

Canada Department of Mines, Geological Survey:

Bulletin No. 34—Physiography and Glacial Geology of Gaspe Peninsula, Quebec. By A. P. Coleman.

Summary Report 1921, Part C.

Canada Department of Mines, Victoria Memorial Museum:

Bulletin No. 36—Biological Series No. 8—Land Snails from the Canadian Rockies. By Stillman Berry.

Memoir 126—No. 4—Biological Series—A Botanical Exploration of the North Shore of the Gulf of St. Lawrence, Including an Annotated List of the Species of Vascular Plants. By Harold St. John.

Ontario Department of Mines, Thirteenth Annual Report; Vol. XXX, Part V, 1921.

South Australia Department of Mines; Geological Survey of South Australia:

Bulletin No. 9—The Iron Ore Resources of South Australia. Mining Review for the Half Year Ended December 31, 1921.

Secretaria De Industria Comercio Y Trabajo, Boletin Minero, Tomo XIII, Numeras 2-3. Mexico.

Societies and Educational Institutions.

University of California—Bulletin of the Department of Geological Sciences, Vol. 13, No. 5. The Briones Formations of Middle California. By Parker D. Trask.

Genesis of the Ores of the Cobalt District, Ontario, Canada, Vol. 13, No. 7. By Alfred R. Whitman.

A Marsupial from the John Day Oligocene of Logan Butte, Eastern Oregon. Vol. 13, No. 8. By Chester Stock and Eustice L. Furlong.

Quarterly of the Colorado School of Mines, April, 1922.

The Science Reports of the Tohoku Imperial University, Sendai, Japan.

OFFICIAL PUBLICATIONS RECEIVED—Continued.

Societies and Educational Institutions—Continued.

Canadian Institute of Mining and Metallurgy, Monthly Bulletin, June, 1922.
Mining and Metallurgy, May, 1922.
American Mining Congress, General Bulletin No. 21, Special Information Service, Washington, D. C.
Mining and Metallurgical Society of America, Bulletin No. 154, March and April, 1922.
Proceedings of the United States National Museum, Vol. 13.
Institution of Mining and Metallurgy Bulletin, May, 1922.
Journal of Geology, April–May, 1922.
Economic Geology, May, 1922.
Memorias De La Real Academia De Ciencias Y Artes De Barcelona, Spain:
  Escolecita De Estopanyo (Huesca.), Vol. XVI, Num. 12. By F. Pardillo.
  La Evulucion Moderna De La Locomotora Su Estado Actual; Su Probable Fututo, Vol. XVI, Num. 13. By Ilmo. Sr. D. Jose Serratt Y Bonastre.
  Prodromus Lichenum Europeorum Fruticulosi Et Foliacei. Adjuntis Tabulis Analitycis Specierum, Cum Ominum Varietatum Formarumque Descriptione, Vol. XVI, Num. 14. By H. Olivier.
  Monografia De Los Phoridos De Las Islas Canarias, Vol. XVII, Num. 1.
  Contribucion A La Paleontologia Del Cretacico De Cataluna, Vol. XVII, Num. 2. By Ilmo. Sr. D. Luis Mariano Vidal.
  Arundo Donax—L., Vol. XVII, Num. 3. By Excmo. Sr. D. Carlos De Camps, Marques De Camps.
  La Intromision Del Academismo Y Yl Modernismo En Las Escuelas De Arte, Vol. XVII, Num. 4. By Sr. D. Felix Mestres Y Borrell.
  Orientacion Actual De La Meteorologia Catalana, Vol. XVII, Num. 5. By Dr. D. Eduardo Fontsere.
  Mis Excursiones Cientificas Del Verano De 1919, Vol. XVII, Num. 6. By R. P. Longinos Navas, S. J.
  Calculo De Los Calores De Formacion Segun Las Vibraciones Infrarojas De Extincion; Ensayo Sobre El Mecanismo De Las Acciones Cataliticas, Vol. XVII, Num. 7. By M. Charles Henry.
  Las Ceras Kiturgicas. Estudio Quimico. Vol. XVII, Num. 8. By R. P. Dr. Eduardo Vitoria, S. J.

Books.

Year Book of the American Bureau of Metal Statistics—Second Annual Issue, 1921.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Hercules Mixer, Wilmington, Delaware.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.

Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Georgetown Gazette, Georgetown, Cal.
Gateway Gazette, Beaumont, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Humboldt Standard, Eureka, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mountain Messenger, Downieville, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Nevada Mining Press, Reno, Nevada.
Oroville Daily Register, Oroville, Cal.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Plumas National Bulletin, Quincy, Cal.
Plumas Independent, Quincy, Cal.
Placer Herald, Auburn, Cal.
Petroleum Reporter, Etna Mills, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Stockton Record, Stockton, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–82 Free-gold property; sell, bond or lease; good values; in San Bernardino County.

02–83 Gold quartz property; three claims, two ledges, good values; in Plumas County.

02–84 Gold channel property; tapped by 450-foot, double-compartment incline. Gravel washes $4.00 per ton, without crushing.

02–85 Ochre; large deposit within five miles of railroad.

02–86 Diatomaceous earth; deposit or tonnage.

02–87 Volcanic ash deposit; pure white, fine-grained; two and one-half miles from railroad.

02–88 Marble deposit; 165 miles from San Francisco, five miles from railroad on good auto road.

02–89 Equity in thirty-five-year lease on 2500 acres promising drift-mining prospects in eastern Placer County. Known channels, not opened; camp buildings and tools.

02–90 Three groups of drift mines in Placer County; several thousand acres. One group opened and ready to mine; probably three-fourths mile of channel. Has steam boiler, compressor, pumps, houses. Sale account of death.

02–91 Drift mining property; about 1 mile of channel, Yuba County, near Bullard's Bar. Price and terms reasonable.

02–92 Washed and screened sand; good quality, sharp and clean, for concrete and plaster. On Northwestern Pacific Railroad.

02–93 Asbestos deposit.

Mineral Products or Deposits Wanted.

03–72 Feldspar and clays. Eastern company contemplating building plant in California.
03–73 A property producing a heavy crude oil, not over 14° Bé.
03–74 One or two tons of scheelite as nearly pure as possible.
03–75 Gypsum for fertilizer; deposit or tonnage.
03–76 Galena; cubic crystals for radio work.
03–77 Block pumice; deposit or tonnage.
03–78 Mill-grade asbestos; for stucco.
03–79 Manganese ore; tonnage.
03–80 Glass sand; deposit.
03–81 Cobalt ore; deposit.
03–82 Manganese ore; tonnage.
03–83 High grade manganese ore.

EMPLOYMENT SERVICE.

Following close upon the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau contemplates registering technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–15 Mining engineer. Technical graduate. Eleven years' experience. Present position chief engineer, large gold mining company. Age, 34; married. References. Salary wanted $3000.

01–16 Civil or hydraulic engineering. Twenty years' experience, railroad, mining, public-service, hydro-electric and municipal investigations and designing. Age 45; married. References.

01–17 Assayer, chemist, metallurgist or anything connected with smelting operations. Thirteen years' experience as assayer, chemist, sintering-machine foreman, blast-furnace and lead-refinery foreman and superintendent of smelter and refinery; Mexico and California. Age 37; married. References.

01–18 Plane table man. Two years' experience as instrument man, in oil field work. Age 25; single. References. Salary wanted $125.

01–19 Engineering office work. Three years' experience, rodman, transitman and office computation and plotting; reclamation and highway work. Mining engineering student. Junior year completed. Age 23; single. Salary wanted $125.

01–20 Oil lease superintendent. Four years' general lease work; nine years' lease foreman with drilling experience. Can handle men, tools and machinery. Age 42; married. References. Salary wanted $250.

JULY, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each divison working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. Tucker, Mining Engineer.

Del Norte County.

The gold quartz strike reported recently from Takilma, Oregon, is really in Del Norte County, three miles across the state line.

The owners are *J. C. Gaither* and *Chas. Reed.* In hydraulicking, two quartz veins carrying high values in gold were uncovered. Width of veins is from 8 inches to 3 feet.

The *Monkey Creek Mining Company* is going to move its stamp mill to Baker Flat, a mile west of Monumental. The mill is to be run by water power secured from Shelley Creek.

Modoc County.

It is reported that there is renewed activity in the High Grade District. The control of the *Big Four mines* has been acquired by Matt. J. Holt. The *Sunshine group* of mines are to be worked under lease by new interests.

Lassen County.

E. Johnson of Leavitt reports the discovery of vein of coal in Willow Creek Valley. He has located 160 acres.

Shasta County.

The *West End Mine,* near Whiskey-town, has been unwatered, and the 100-foot shaft retimbered. A new head-frame is being installed preparatory to starting development work. Four men are employed. Walter Parsons, Superintendent.

The *Gold Leaf Mine*, which is situated four miles west of Redding, in the Shasta Mining District, is to be reopened by Ira Judson Coe of San Francisco.

There is a vertical shaft 400 feet deep on the property.

The *Sybel Mine* in French Gulch District is producing some high grade rock from the lower levels. The 5-stamp mill is operating continuously. Fifteen men are employed.

The *Niagara Mine*, adjoining this property, is being developed by the same company. Harry Thompson, Manager.

The *Black Diamond Group* of claims, situated four miles west of Redding, in Sec. 5, T. 31 W., R. 18 W., Shasta Mining District, is being developed by the owner, T. S. Callender of Redding. There are two systems of veins on the property; one strikes north 60° west, dipping 60° south, the other strikes north and south and dips 80° east. The country rock is meta-andesite, with intrusions of alaskite porphyry. A number of shafts have been sunk on the property, from 10 to 50 feet deep.

George W. Boswell has made a rich strike on his *Last Chance* mines.

L. W. Vaughn of Atwater, Merced County, has located six copper claims on a large ledge he discovered on the north side of Pit River about 20 miles north of Copper City, in what is called the Canyon Creek Mining District. The locations are named: Bertagua, Live Oak, Bagley Mountain, Last Chance, Southern Copper and Atwater.

The *Bell Cow Mine*, situated near Harrison Gulch, and owned by Frank A. Greene and associates, of Redding, has been taken under option by Chicago interests, represented by W. S. Robinson and McCoy of Chicago. It is stated that development work will be started on the property in the immediate future.

Frank Walker took out four and three-eighths pounds of gold, worth $1,000, from a pocket that he discovered on his claim on the Middle Fork of Salt Creek, in Shasta Mining District, four miles west of Redding.

The *Mountain Copper Company* received $16,410 and the *Balaklala Copper Company* $5,877 to satisfy judgments given in the United States District Court in March, 1921, on account of excessive assessments made in 1919. The Board of Supervisors gave the Mammoth Copper Company and the Mountain Copper Company a large reduction in the assessment on their mines this year. The valuation of the Iron Mountain mine was reduced from $350,000 as returned by the assessor, to $235,000. The assessment of the Mammoth group of mines was reduced from $275,000 to $185,000 and the valuation of the Mammoth's Sutro mine was cut from $40,900 to $26,000.

Stock Asbestos Mines, which are situated in Secs. 1, 2, 3, 4, 33 and 34, T. 37 and 38 N., on Miers Creek, and about five miles west of Sims Station, are being developed.

The country rock is serpentine through which numerous dikes of diorite and gneiss have been thrust. This serpentine belt carries chrysotile asbestos, both slip and cross fibre, and amphibole and moss fibre of all kinds. Extensive exposures of both chrysotile and amphibole variety of asbestos have been discovered. Four men are employed in development work. Development operations are under the supervision of Chas. H. Spinks, of Berkeley, H. E. Stock of San Francisco, owner.

Reference: State Mineralogist's Report XIV, pp. 752–755.

Siskiyou County.

At the *Jefferson Consolidated Mine* on the East Fork of the Salmon River near Cecilville, three giants are under operation on the Middle River bar.

J. L. Garrett and associates have taken over the *Flag Mine* in the Humbug district, northwest of Yreka. They have been operating the property for several months.

The *Eliza Mine* is being operated by O. A. Lawson of Humbug, who has a crew of men on development. This property is two miles west of Humbug.

The *Roosevelt Mine,* on Jack Davis Gulch, a tributary of the Ukonon, and south of Happy Camp, is being operated by the *High Light Mining and Milling Company* of New York.

The *Ida May Quartz Mine* on Eddy's Gulch between Cecilville and Sawyer's Bar, is being operated by A. J. Ball.

The *Mountain Laurel Quartz Mine* and mill situated in the same district is operated by Fred Gowing and associates of San Francisco.

Trinity County.

Gold dredging on the Trinity River is in a more or less stationary condition.

Two new dredges are under construction, one is being erected by *L. Gardella* of Oroville, California, on a bar on the south side of the river, a mile and a half below Lewiston.

The other dredge is being erected by the *Lewiston Dredging Company* at the Martin ranch above Lewiston. A pit has been excavated, derrick and machine shop erected, and the hauling of the machinery from the Valdor dredge is under way. The area to be dredged is approximately 700 feet wide and a mile long.

The *Valdor dredge* is being dismantled and its parts will be used in construction of the new dredge. The only dredge in operation is the 11 cu. ft. boat of the *Trinity Gold Dredging Company,* who are operating five miles above Lewiston. The *Pacific Dredging Company,* a subsidiary of the Yukon Gold, has shut down and will dismantle its all-steel dredge at Carrville, preparatory to shipping it to the Federated Malay States for use in tin dredging.

The *Estabrook dredge* which has been shut down for a considerable period may be started in several months.

The *Shasta Dredging Company,* who have one 5-cu. ft. Bucyrus dredge in operation on Cottonwood creek near Gas Point, Shasta County, have bonded the Von Matre ranch near Minersville on the Trinity River. Drilling operations are now under way prospecting the ground.

The *Gold Leaf Mine,* which is situated between Trinity Center and Delta, is being developed by Bert Bassham, Ban Jenkins, and Eric Peterson of Trinity Center.

There is much activity in the platinum belt along Hayfork Creek, in the vicinity of Wildwood. Twenty to thirty miners are working and the creek is staked out in claims for a distance of five or six miles..

The *Trinity Mohawk Group* of mines, situated on the south slope of the Trinity range of mountains, between Mooney and Little Papoose gulches, is being developed by James King of Redding. The property is 15 miles northwest of French Gulch.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

Amador County.

On the Mother Lode in Amador County more large gold mining companies are in operation than in any other county of the State, and the total investment in properties is greater than elsewhere in California, although the present total gold production is not yet equal to that of Nevada County. Conditions are improving and some reductions in operating costs are reported. Several companies are carrying on developments in their lower levels. The Central Eureka is not milling ore at present on account of work in the shaft. A new venture that is being watched with great interest is the rehabilitation of the Moore Mine. The principal production now is from the Argonaut and the Kennedy Mines, and the Plymouth Mine.

Argonaut Mine. This mine is opened now to an inclined depth of 4800 feet and has taken, at least temporarily, from the neighboring Kennedy the title of the deepest gold mine in the United States, the 4800 level being about 4123 feet deep vertically. Stoping is going on from the 4650 and 4800 ft. levels. The vein continues of good width in the lowest stopes, which are carried several hundred feet, with the vein averaging about 20 feet in width and consisting of solid quartz and ribbon rock. Stopes are timbered with heavy square sets and filled with wall rock from crosscuts.

Encouraging results are reported from work at the south faces, where a wide vein of quartz, said to be of milling grade is being followed into territory beyond the former south boundary of the ore shoot, as previously shown in the levels above. The Argonaut Mine has only one vein, as far as shown by developments, and for many hundred feet have been working upon one ore shoot. The mill is handling about 270 tons of ore a day and a crew of 180 men are employed.

This company is at present involved in litigation with the Kennedy company, a suit having been filed by the latter for $500,000 for alleged losses as the result of fire and water when the mines had to be flooded in 1920. The Argonaut company has filed a cross suit for $800,000 and both sides are at present devoting attention to preparation of their cases.

Bunker Hill Mine employs at present a crew of about 50 men. No new sinking has been done, the present depth being 3440 feet, which was reached in a winze from the 2800 level. Search at present is for richer ore bodies than the schist ore, which is low grade. The mill is being operated part time. The present management is interested in finding, if possible, more ore in the slate.

Central Eureka Mining Company has suspended production during extensive improvements to the plant and shaft. A new steel headframe has been completed and 53-lb. T-rails are being laid in the shaft at present. When this work is finished the shaft will be in such condition that a greatly increased tonnage per day can be hoisted. Operations were previously hampered on account of the old strap iron rails and the small skips. The work will be completed and the mill again in operation probably before the first of September.

Prospecting work in the South Eureka by the Central Eureka Mining Company has not yet revealed any important new ore bodies, according to Albion S. Howe, Superintendent.

Fremont Mine. Prospecting and development are still being continued with a crew of about 20 men. The Fremont shaft is now 2900 feet deep. No ore has been crushed by the present company, the mill having been idle since 1918.

Kennedy Mine. Only two levels are said to be accessible in the Kennedy Mine at present—the 3900 and 4050. No shaft sinking has been done since the mine was unwatered last year. The Kennedy has been working two veins, which in the deeper levels appear to be converging both downward and to the south; in the adjoining Argonaut workings only one vein has been stoped and none of the other contacts or fissures have revealed ore where shown by crosscuts.

Enough ore is being hoisted at the Kennedy to run the 100-stamp mill at about one-half capacity. The plans of the management for development have been interrupted by the pending lawsuit with the Argonaut.

Moore Mine. This property, a mile south of Jackson, is of interest to many of the residents of that town who have supplied funds for the rehabilitation of the mine. It had been idle about 35 years when the present company started work August 1, 1921. They have issued 2,250,000 shares of stock and have realized $153,750. About 300 acres of land are controlled, with a maximum length of three-fourths of a mile north and south and a width of one mile.

The old shaft and other workings have been reopened. The shaft was caved full to the water level, at about 100 feet, but when cleaned out it was found that the old spruce timbers below that point were in good shape and few needed replacing. The 500 level drift was run on the black slate fissure and was caved full. This was reopened at great expense. The shaft dips east 52 degrees and has a course north 26 degrees east. There are levels at inclined depths of 106 ft.; 169 ft.; 344 ft. (fourth) and 435 ft. (fifth). Since reopening, the shaft has been continued about 100 feet up to July 10th, and a level called No. 6 is soon to be started. According to H. G. Perry, General Manager, the ore shoot opened in the old works on 4th level is about 90 feet long as far as present development shows. He believes that between 4th and 5th levels a fault threw the upper part of ore shoot 75 feet into the footwall. On the 5th level the pay vein has been opened for 120 feet. Samples taken and assayed by Perry in this distance indicate from 4 to 12 feet of rich ore, the assays running as high as $65 a ton. There has been no systematic sampling of the mine by an outside engineer, nor have any mill runs been made, but much of this rock shows finely divided free gold. The ore pinches to a wedge on the west end and in the east face shows 4 feet wide. It is a vein of solid quartz showing ribbon structure. It does not lie in the main fissure, but occupies a fissure striking nearly due east into the hangingwall schist, which itself, near the vein, appears to carry some gold, but has not been opened enough to show whether or not it will make an ore body.

The main fissure in the black slate was explored in the old works on 5th level by a drift 400 feet long in heavy slate, which is said to show no ore here. At its north face a crosscut of about 60 feet eastward through the slate shows in its face the hard greenstone.

A mill of twenty 1200-lb. stamps is being built. Foundations for it have been completed and timbers were being framed at time of visit, July 10th. It is thought it will be ready to run by September. Standard Mother Lode practice will be followed, concentrating to be done on 12 six-ft. Frue vanners. An inclined tramway 500 feet long will lead from the hoist to the mill and ore will be delivered in 2½-ton side dump cars, dumping automatically in the mill bins which will have a capacity of 500 tons. A 100-horsepower hoist, with a depth capacity of 3000 feet, is planned. Electric power will be furnished from the Electra power line which passes nearby.

For impounding mill tailing a reinforced concrete dam 360 feet long and 25 feet high has been built. This is 30 inches thick at the bottom, 15 inches thick at the top, with a buttress every 15 feet.

Following are estimated costs of some items of the surface plant and cost of reclaiming underground workings, as given by the general manager:

Cost of buildings, equipment, labor and supplies to reclaim mine workings, including second-hand compressor of 500 cu. ft. capacity	$35,000 00
20-stamp mill erected, ready for use	35,000 00
Concrete tailing dam, complete	5,000 00
Hoist and motor (100 h.p.)	6,000 00

The company was promoted by Geo. F. Snyder of San Francisco, president; Wm. G. Snyder, vice president, and Horace G. Perry, general manager, of Jackson.

Treasure Mining Company. The mill on this property is idle at present, pending the development of more ore. The workings have reached a depth of 2900 feet. The ore here is the grey schist sulphide ore, which is a replacement deposit as distinguished from the quartz veins and stringers of the slate zone. It is of lower grade than the latter as a rule and under recent costs has been workable at a small margin of profit. The Treasure mill, described in a previous report, differs from others on the Lode, Hardinge mills being used in place of stamps. It is anticipated that development underground will soon justify resumption of milling.

The old *Penolay Ranch Mine* at Jackson Gate has been leased by J. Muller. It is a prospect opened at present to a depth of ninety feet, which has lain idle for a great many years. Muller plans a five-stamp mill.

The *Plymouth Mine* continues in steady operation and remains one of the three principal producers of the county. There is a total force of about 150 men employed at present. Development of good ore has lately been reported from the 3700-ft. level. The Plymouth is at present the northernmost mine in operation on the Lode as far as production is concerned, although some work has been started lately looking to the reopening of old properties near Plymouth.

West Side prospect, two miles west of Jackson in the diabase, is being opened by Geo. S. Downing and associates of Jackson. A shaft has just been started to prospect a rich narrow vein. The claim is south of the old Monterichard Mine.

El Dorado County.

Geo. V. Sinclair has begun work on the dump material at some of the old mines at Georgia Slide, near Georgetown.

The *Gold Bug* property near Georgetown has been leased to J. B. Kelliher, Wm. Henneuse, and Wm. Lockridge and work is now going on.

Some prospecting is being done at the old *Mt. Pleasant Mine* near Grizzly Flat.

Goodwin & Luster are running 2 stamps on the *Red Wing Mine* which is a short distance south of the old Union Mine, between El Dorado and Nashville. This mine is opened by adits.

The *Vandalia Mine,* 4½ miles southwest of Shingle Springs, is reported to have been leased recently. This mine is on a deposit of sulphide ore formed by the replacement of the country rock. It was operated for several years prior to 1900. The ore carries about 5% of sulphides.

Von Kotsch & Moore are opening a prospect 4 miles easterly from Georgetown and have milled a few tons of ore in a small mill.

Placer County.

Eagle Gold Mining and Milling Company of Delaware and Los Angeles has made part payment on a quartz claim owned by Wm. M. Bree in Sec. 2 and 3, T. 15 N., R. 11 E., on the North Fork of American River, a mile and a half upstream from the mouth of Humbug Creek. They have also made a number of locations nearby on which no work has been done yet. On the Bree claim there is a crosscut about 57 feet through the footwall, to the vein which has been drifted upon for 27 feet and which shows 4 feet of solid quartz at the face, with a black slate footwall and grey schist hangingwall. The vein strikes a little west of north. Half a ton of ore has been sent out for a test. Random assays are said to show from $2 to $20 a ton from the surface of the vein. There is an old inaccessible adit on the claim, but the length of this is uncertain. The nearest active mine is the Pioneer, about 2 miles southwest.

W. D. Chambers and associates of San Francisco are reopening the *Centennial Mine* on the west side of Duncan Hill, 2 miles southwest of Auburn. Chambers has reached the level of the old adit workings through a shaft about 175 feet deep and reports that considerable ore left in sight by the last operators gives very encouraging assays. The same people have a bond on the adjoining *Conrad Mine* which is on a vein parallel to the Centennial. Both mines have been worked to a depth of 180 feet and made considerable production, but have been idle for about 30 years. They were opened through a series of adits and shallow shafts. A small stamp mill is planned.

Pioneer Mining Company has just finished a run of several months at their *Pioneer Mine* on the south side of the canyon of North Fork of American River, near Damascus. About 4000 tons of ore from the Lynn vein have been crushed during this last run. This vein runs from 4 to 7 feet in width in most places, and is composed of good looking ribbon rock. It has been worked so far to a depth of 1450 feet by adits driven from the side of the canyon, and by a winze sunk from the lower adit. No. 3 crosscut adit cuts the Pioneer vein at a distance of 390 feet, and Lynn Vein at a distance of 1400 feet from the portal and a depth of 700 feet. It is run 2525 feet on the Lynn vein. No. 7 adit is a crosscut 2800 feet long to the Lynn vein and from this level the vein has been drifted upon for 1475 feet. The winze from No. 7 is 242 feet deep, showing the vein to be from 2 to 9½ feet wide on the bottom level, where it has been drifted for 225 feet. The winze workings are now full of water. Some large stopes have been worked, many from 200 to 300 feet long, and from No. 4 to No. 3 the vein has been stoped for a length of about 1000 feet, showing in most places there a width of 2 to 5 feet of low and medium grade ore. Recent stoping has been for a length of 200 feet between No. 5 and No. 4. There was some ground stoped from the 80-foot winze level for a length of 250 feet to fifty feet above No. 7, but this was done some years ago and is about all that was mined below No. 5. There are a number of blocks of ground about No. 7 that will probably be mined, as the assays indicate probable ore. All this work has been upon the Lynn vein, the Pioneer vein having received no attention below No. 3 adit. A strong dike accompanies the Lynn vein and is a favorable indication for the persistence of the deposit. The vein strikes N. 32 degrees W. and dips N.E. about 70 degrees.

From No. 7 (elevation 3050 feet) the ore is sent by tram to the mill, a distance of 1128 feet and about 550 feet lower. The mill, built in 1888, contains a 9″x12″ breaker, twenty 1050-lb. stamps and six 4-ft. belt vanners. It has a capacity of 60 tons a day, but is about worn out. The company is planning at present to replace it with a modern plant, and may possibly replace the stamps with Hardinge mills. There is a cyanide plant with a capacity of one ton a day for working the concentrates, which make up about 2½ per cent of the ore and are worth about $50 a ton. The ore milled at the Pioneer at different times has ranged from $3 to $16 a ton. The mill lately has been operated by electricity, but at one time work was done much cheaper with water power.

Work has been resumed during the month at the *Rawhide Mine* on the North Fork of North Fork of American River, 3 miles from Towle.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Madera County.

Much of the gold mining record of Madera County is now a matter of history that began in '49. Previous to 1893, what is now Madera County was a part of Fresno County and production was accordingly credited to the latter. The total amount, from 1880 to 1892, inclusive, so credited was $1,350,000. The gold production of Madera County in 1893 was valued at $150,696. Since that time it has gradually decreased. In 1921 there were five producers, sixty-nine tons of ore were worked, and $1,053 in gold produced.

Although activities have greatly decreased, there remains plenty of evidence that all of its mining history has not been written. It is true that many of the 'mines' are now cattle ranches, and also that much of the land is being rapidly taken up under the 640-acre stock-raising homestead act.

Such conditions are not conducive to prospecting and act as a detriment to the mining industry, nevertheless activities have continued in a limited way, and are again slowly reviving in this county, as in most other gold mining sections of the State.

A trip through the principal mining section, including the old camps of Grub Gulch, Raymond, Coarse Gold, O'Neals, North Fork, and Hildreth revealed conditions at the mines described in Report XIV of the State Mineralogist, as noted below. A number of properties not mentioned in the above report are also described.

Gold Mines.

Abby. Idle. The 10-stamp mill formerly on this property has been wrecked and sold.

Ackers. Idle.

Baker Gold Mining Company. Idle.

Balfron. Abandoned.

Butterfly. This is now a part of the Savannah Group (patented), owned by Maxfield and Lisby of Fresno, and Mark Sullivan. Idle.

Caledonia. Idle. Owner, O. B. Allen, Oakhurst, California.

Canary. Assessment work only. Owner, John Day, Woodland, California.

Colorado. Assessment work only.

Crystal Springs. Abandoned.

Daisy. Idle.

Diana. Abandoned.

Empire. Idle.

Enterprise. Property recently sold to Boston people. It was worked some in 1921. Idle at present.

Five Oaks. This group is now known as the Carnation and is a part of the Kroromick Mining Company's holdings.

Flying Dutchman or *Hoboken.* Abandoned.

Freda. Idle.

Gambetta. Owner, Walter Starr, San Francisco, California. It has been idle the past four years.

Golden Road. Abandoned.

Hanover. Idle.

Hawkeye. Same as the Colorado. Assessment work only.

High Grade. Assessment work only.

Hoboken. (See Flying Dutchman.)

John W. Coats. Same as the Enterprise.

Josephine. Idle.

Kroromick Mining Company. (See Texas Flat.)

Lady Ellen. Idle.

Lucky Bill. Considerable work has been carried on at the Lucky Bill during the last year or two and it has been bonded several times. John Morrison, owner, Eureka, California.

Melvin, Mountain Lilly and *Mary.* These properties are now a part of the Kroromick Mining Company's holdings.

McKenzie-Minturn Mine. Idle.

Millenium. Idle.

Morning Star. Idle.

Mountain View. Idle; cattle ranch.

Mud Springs. This properly is now owned by James Mussel of O'Neals. It is under bond to the Italian-American Mining Company, and development work has been carried on for the past three months; retimbering, etc. A new Lane mill has been put in place at the mine.

New Citizen. Same as Pure Gold.

Pure Gold Mining Company. Defunct.

Quartz Mountain. Defunct.

Ragesdale. Idle.

Savannah. Patented. Idle.

Starbuck. Now known as the *Hornets Nest.* Owned by Thos. S. Baker of O'Neals and Mrs. S. A. Wilson, 920 H street, Sacramento. A drainage tunnel, now in 120 feet, is being run and will soon tap the workings. A general sample from surface showings assayed $78.55 in free gold. It is equipped with an arrastra in which the ore will be treated.

Starlight Group. Idle.

Texas Flat. Now known as the Kroromick and owned by the Kroromick Mining Company, H. A. Krohn, president, Coarse Gold; Philip Rowe, vice president and treasurer; Maurice McMicken, secretary, home office, Colman Building, Seattle, Washington. Operating office, Coarse Gold.

Property includes the Texas Flat, Mountain Lilly, Waterloo, Consolidated Four, and Five Oaks Group. Since the last report the shaft has been sunk 200 feet. Level No. 4 is now in 1100 feet and No. 5 is in 1250 feet.

Workings are now down 1200 feet (7th level), where the vein, which is five feet in width and of good milling grade, has been drifted on for 900 feet. This drift is being continued. A streak of high-grade was recently cut that showed wire-gold in the quartz. The gold is light colored and low-grade, being worth about $13 per ounce. Development work has been carried on continuously by contract at $5 per foot. The mine does not make enough water for milling purposes, and there is a scarcity of water in the summer.

The management figures 250,000 tons of $12 ore blocked out, and will start the mill as soon as water is available, with the expectation of making a run of several years at least.

Volcano No. 1. Idle for many years.

Washington. Abandoned.

Waterloo and *Consolidated Four.* See Texas Flat.

Zulu. Abandoned.

Silver-Lead Mines.

Star Mine. Idle. Property is in litigation.

Granite.

McGilvray-Raymond Granite Company. This company is employing 100 men and is increasing the force as fast as help can be secured. It is operating on the 'American plan' and the force is now composed almost entirely of Americans in contrast to the Italians and Scotchmen who formerly did much of the carving. The company has recently supplied stone for the Anglo London Bank and Federal Reserve Bank buildings in San Francisco and for the extension to the State Capitol at Sacramento. Contracts for one and a quarter million dollars worth of work are on hand, and the outlook is good for continued and increasing activity.

Raymond Granite Company. F. E. Knowles, president; H. L. Knowles, vice president; E. L. Knowles, secretary and treasurer. Office 3 Potrero avenue, San Francisco; J. P. Graham, superintendent at quarry.

Company is employing an average of 175 men. American plan. Stone cutters are paid $8 per day and quarrymen $6. Sullivan drill sharpeners have been installed and electric power is used throughout. The company has recently furnished granite for the new State Building in the Civic Center, San Francisco, and for the Standard Oil Company's Building, San Francisco. The outlook for the year is good.

The following properties have not previously been of record:

Silver-Lead.

Albino Mine. Owner, H. A. Krohn, Coarse Gold. One claim, located on the head waters of Minaret Creek just below the Buttes. There is a road to Mammoth, the nearest town, and then a ten-mile trail to the property. The claim is situated just on the edge of the timber line at an elevation of about 9500 feet. Water is plentiful. The deposit was discovered in 1878 and has been held by the present owner for the past twenty years. Country rock is granite, diabase, limestone and porphyry. The deepest shaft is twenty feet, but the ore body has been trenched for four hundred feet in width with galena showing all the way. A general sample of the croppings showed silver 18.2 oz.; lead 37%; nickle 1%; copper 9%; gold $2.07.

Silver Horde. Owner, B. Manners, North Fork. Property consists of ten claims discovered in 1908. Located on unsurveyed land in the North Fork Mining District just north of the Minarets. At present Friant is the nearest railroad point, but the Minarets and Western Railroad (under construction) will bring rail transportation facilities much nearer. There is an auto road to Soda Meadows, thence a ten-mile trail to the group. The property lies at an elevation of 8500 feet, with easy grades. Good timber can be obtained within one-half mile and water is available, under 1000-foot head, if desired. The deposit is in the metamorphic area with granite two and a half miles to the west. Slates and volcanics comprise the country rock. There are three large and two small veins proved for 6000 feet in length. The strike is N.E.-S.W. and dip about 80°. The greatest depth opened up is fifty feet, the vein being twenty-two feet wide where exposed. It carries lead, silver, gold and copper. The principal value is in the silver, assays running from forty to three hundred ounces per ton. About two thousand dollars has been expended to date in development. Equipment consists of prospector's outfit and hand tools only. Tellurides, and tungsten in the form of wolframite, are reported to occur in this vicinity.

Gold Mines.

Eagle Mine. Owners, Noble and H. C. Melvin, Coarse Gold. Property located in the Potter Ridge Mining District on Deadwood Gulch, about three miles northwest of Coarse Gold. Raymond, the nearest railroad point, is seventeen miles distant by good road. There are two claims known as Eagle No. 1 and No. 2. Elevation 2600 feet. Scrub oak and pine cover the claims and there is plenty of water. The lead was a blind one, only discovered in 1921, although early-day placer operations had been carried on almost to the deposit. Country rock is schist and slate (Calaveras?). The ore-body consists of a mass of quartz stringers twenty to twenty-five feet in width with talc gouge, the quartz carrying free gold. It strikes N.W.-S.E. and dips almost vertical. Proved on the surface for three thousand feet. Development consists of a shaft thirty feet in depth and a 75-foot drift on the vein. Hand tools are used. The mine is equipped with an arrastra of 6-ton capacity driven by gas engine. Two men are working.

Logan Mine. This is an old property consisting of one unpatented claim recently acquired by Dr. Wyckoff et al. of Los Angeles, and it is reported that work will start soon. The workings are flooded. There are two connected shafts, said to be one hundred and two hundred feet in depth, respectively. The deposit consists of a quartz vein in granite. The gold is free. The property is on the River Route from Madera to Coarse Gold, just above Langdonville. Raymond, the nearest railroad point, is fourteen miles distant.

Stayton Mining Company. Property consists of four claims, two patented and two unpatented, in Secs. 8 and 9, T. 8 S., R. 20 E., in the Potter Ridge Mining District. Raymond, the nearest railroad point, is nine miles westerly by good road. The claims lie at an elevation of sixteen hundred feet and are covered with scrub oak and pine. There is plenty of water. The property is an old one, reopened by the present owners in 1915. There are two veins in granite country rock. The strike is E.-W. and dip 30° to 45° south. Veins are from six inches to one foot in width and carry auriferous pyrite with free gold near the surface. Development consists of a 90-foot incline shaft and two levels driven forty and fifty feet, respectively. Equipped with gas-engine hoist, 2-stamp mill and concentrator. Hand tools are used in mining. Three men working.

Sunshine Mine. One claim owned by F. M. Ackley of O'Neals, who works alone. There is a road to within one mile, then a trail. Situated in Sec. 5, T. 10 S., R. 22 E. Friant is the nearest railroad point, and O'Neals the nearest town. Water can be obtained the year round from three springs. Deposit consists of quartz vein one to five feet in width carrying free gold. Greatest depth on vein thirty feet, in tunnel. The owner has thirty-five tons of ore out ready to mill.

Small and intermittent mining operations are carried on by many individuals in the county in the hope of finding a pocket. In most cases the veins are scarcely more than stringers but they pan freely and occasionally develop a pocket.

T. J. Jordan of O'Neals has an arrastra run by water power on the San Joaquin River below Hildreth, where he is working a claim. John H. Morris and J. H. Downey of O'Neals are also working single claims and Marion Markle of O'Neals has three claims on Quartz Mountain, one mile from the North Fork highway, on which there are small veins carrying free gold.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Kern County.

Mojave Mining District. This district is three miles south of the town of Mojave. For the last few years, the district has been a negligible factor in the production of gold. The high cost incident to the world war resulted in an almost complete paralysis of what little work was being prosecuted in the district. The production of the district runs into several millions, as the records of the old Exposed Treasure and Queen Esther mines will prove. A few of the old-timers continued to have faith in this district, and it appears that their faith was justified, for several months ago an entirely new vein was discovered by Mr. Percy Wagman. This property has been acquired by what is known as the *Yellow Dog Mining Company,* from Messrs. J. Withers, P. Wagman, and B. Fisher. A quarter interest in the company has recently been bought by strong financial interests of Los Angeles, represented by Mr. Ellis Mallery. The property consists of eight claims, known as the Yellow Dog No. 1, No. 2, No. 3, No. 4, No. 5, and No. 6, and the Francis H. No. 1 and No. 2. These claims all lie in Secs. 29 and 32, T. 11 N., R. 12 W., S. B. M. It appears that about twenty years ago, a spar vein 8 to 10 feet wide carrying some manganese was located, and a small amount of development work in the way of shafts sunk on the vein to a depth of 20 to 60 feet was done. The assays of samples taken from these workings, however, ran extremely low, $2 to $3 a ton, and the owners therefore suspended all further work. It now appears that what was taken as the hangingwall by the old owners has proven to be the wall of the quartz vein discovered by Mr. Wagman, and this has been found to run for over 500 feet alongside of the old spar vein.

Like the great Premier Mine of British Columbia, a few dollars spent on crosscutting would have revealed this ore body to the old owners. Several samples taken over a width of 43 feet are reported by the owners to have given the following results: 9 ft. of spar vein, $2.93; 34 ft. of quartz vein, sampled in 5-ft. sections, averaging better than $25 gold value per ton.

The vein courses approximately north and south with a dip of about 60 degrees to the west. It appears to have all the earmarks of making a mine of real importance, and again bringing the Mojave District to the attention of the mining world.

San Bernardino County.

Monumental Mining District. This district derives its name from Monumental Peak. This peak is approximately ten miles north of Parker, Arizona, and eight miles west of the Colorado River, in the Whipple Range of mountains.

Copper Basin Consolidated Mines Company. This company owns nine claims, or 180 acres, in the Monumental Mining District, about fifteen miles northerly from Parker, Arizona. The low hills comprising the basin have an elevation of about 1000 feet above sea level.

The entire region seems to have been covered by a basalt flow at one time, but this to a considerable extent has been eroded. Underlying the basalt are found rhyolites, quartz porphyries, and diorites. The quartz porphyry and diorite occur in wide dikes and cover the entire surface of these claims. They strike north and south and dip from vertical to about 45 degrees easterly. The ledges have the same strike and dip as the dikes, and to a depth of about 100 feet the ore occurs as a copper carbonate, the oxide of copper also occurring in places. Two well defined zones of mineralization occur in the porphyry. One has a width of 5 to 40 feet, and can be traced for about 2000 feet.

The ore is developed by open cuts, tunnels and shallow shafts. One shaft is down 100 feet and at the bottom shows a vein 8 feet wide of 5% copper. This shaft is now in sulphide ore consisting of chalcopyrite, pyrite and Bournite. The shaft was sunk on the dip of the vein, which is about 45 degrees. About 600 feet from this shaft is another vein on which a vertical shaft 80 feet has been sunk and the bottom just appears to be entering a sulphide zone. Assays running 10% copper have been obtained from the bottom of the shaft. Tests which have been made by the Southwest Engineering Company of Los Angeles on the sulphide ore indicate that the flotation process could be used for the recovery of the copper.

Mr. J. S. Curtis is president of the company, which has offices at 710 Lankershim Building, Los Angeles.

Rincon Mines Company. This company owns 28 claims in the Monumental Mining District, about 25 miles north of Parker, Arizona, near the Colorado River. These 28 claims are divided into five groups, as follows: The Rincon Copper Group, 12 claims; the Rincon Placer Group, two claims; Hematite Gold Group, four claims; Klondike Group, five claims; Owl Group, five claims.

The Rincon Group millsite and mill are on the banks of the Colorado River.

The Klondike Group is situated four miles to the northwest of the Rincon Group, and the road to same from the Rincon will pass by the Hematite Group.

The Owl Group lies a few miles north from the Rincon Group, a very short distance from the Colorado River.

The Rincon Group consists of rolling hills, composed of porphyry dikes, diorite and monzanite, these formations in places being capped by basalt. There are several veins, all dipping at an angle of about 25 to 30 degrees. The strike of these is east and west, and the dip is to the north. The vein matter is continuous from the highest hill, about three-fourths of a mile from the river upon which it outcrops through all the other hills almost to the mill, and runs through from one gulch to another. The vein has been opened up along the sides of several of these gulches, sufficiently to show conclusively the continuity, and ranges from 18 inches to over 6 feet. The majority of these workings show about three to four feet of copper carbonate ore. Some bornite copper ore has been found in places, and undoubtedly at sufficient depth the carbonates will change to sulphides of copper. Two carloads of ore shipped to the Humboldt smelter gave smelter returns of 5% copper; and $22 gold per ton. A small 25-ton sulphuric acid leaching plant has been erected on the property, to be used as an experimental plant to leach the copper carbonate ores. The ores were simply crushed and leached with sulphuric acid, and the copper precipitated on scrap iron. The large extent of mineralization would warrant the company in developing this Rincon Group more fully, to ascertain the average content of copper and gold, which the ore bodies contain.

The late Murry M. Harris was president of the company, and A. Fritch is secretary, maintaining offices in the Grant Building, Los Angeles.

Randsburg Mining District. The silver-bearing region of this district continues very active, and the thirty or more companies therein are vigorously prosecuting their development work.

The outstanding features of the month were the discovery of a new vein on the 600-ft. level of the Coyote Mine, and reported finding of ore in the Grady shaft, at a depth of 845 ft. The vein found on the sixth level of the Coyote Mine was said, by the company's superintendent to assay 50 to 75 ounces silver per ton.

We have not as yet had a full confirmation of the finding of ore in the Grady shaft. If it be true, it means that the development of the silver section of this district is in its bare infancy.

Ben Hur. The Ben Hur Company of the Divide District of Nevada has acquired what was known as the Dry Wash Claim. This was formerly owned by Heckelrath, Hess, Price and Hammer, who had sunk a shaft 75 ft. deep and had done about 125 ft. of open cut work and trenching on the various veins on this claim. This claim lies west of the so-called 'dyke' of the district. Five to six veins appear to outcrop within its boundaries. The strongest of these is the Ben Hur vein, which averages, where trenched across, 8 ft. The formation is schist, highly silicified.

Under the direction of Mr. A. B. Hall, a shaft 4½′ x 8′ in the clear has been sunk to a depth of 125 ft. and he anticipates cutting the vein in this shaft at a depth of 200 ft. Assays running 5 to 6 ounces of silver have been obtained from some of the open cuts and trenches. From the personal inspection which the writer made of this property he was strongly impressed by the very competent manner in which this claim was being explored.

California Rand Silver, Inc. The following has been abstracted from the company's June report:

The company declared dividend No. 30 of 2 cents a share, representing a distribution of $25,600 for the month. This makes a total of 54 cents per share since January 1, or total dividends for this year, to date, of $691,200.

A fair body of ore of a shipping grade has been discovered on the sixth level north. The work of extending the drifts on the seventh and ninth levels is being pushed with the hope of encountering the same ore found on the sixth level north.

On the eighth level in 806 drift a great body of milling ore has been opened up. The ledge here is from 4 to 10 feet wide and has been explored for a distance of 250 feet.

On the ninth level south, in drift 913, which has yielded a large amount of shipping ore, an extension has developed 4 to 12 feet of milling ore.

EXTRACTION AND PROGRESS.

Ore to mill	4178 tons
Ore to smelter	1102 tons
Waste	2382 tons
Total footage for month	1242 feet

MILL REPORT.

Total ore milled	4178 tons
Average heads, gold	$1 48 per ton
Average heads, silver	14 47 per ton
Average tails, gold	50 per ton
Average tails, silver	1 10 per ton
Per cent extraction, gold	72 90 per ton
Per cent extraction, silver	92 40 per ton
Per cent extraction, total	90 80 per ton
Recovery, per ton	14 71
Total recovery on 4178 tons	61,483 44
Average concentrate value per ton	278 00
Tons concentrates produced at $278	221 16

The company has developed a water supply at Teagle Springs of 30,000 gallons per day. A 12,000-ft. pipe line will be installed to convey this water to the mill, thereby effecting a saving of $45 per day.

Vanadium Gold Co. This company has acquired what was formerly known as the Louisiana-California Mining Co., located 8 miles north of the town of Goffs. The property consists of 10 claims or 194 acres and was discovered in 1902 and worked till 1908, when it was sold to the Laiser Rae Company. In 1911, it was taken over by the Louisiana-California Mining Company, and, in 1912, by the present company. The claims are located at an elevation of 3600 feet, on a low rolling range of mountains.

The vein is of typical quartz type, outcropping strongly across the surface of the claims, and carries gold, silver and vanadium values.

It is opened by a series of incline shafts, the deepest of which is 900 feet. A 100-ton concentration plant was erected by the old company, power being furnished by gas engines for both mine and mill. Distillate and tops have been used as fuel.

The present company for the last eight months has been developing and blocking out ore, putting in raises and ore chutes and getting ready for active operations. Scarcity of water has been one of the drawbacks in times past, so the present company is developing an additional water supply to enable the mill to run both day and night.

The following are the officers of the company, having head offices at 310 S. I. Ferry Terminal, New York City: President, L. C. Butler; Secretary, A. E. Post; General Manager, H. W. Evans.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. COLLOM, State Oil and Gas Supervisor.

From June 10, 1922, to and including July 8, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well	Field
KERN COUNTY:					
Belridge Oil Co.	34	30	24	17	Elk Hills
Belridge Oil Co.	34	30	24	3	Elk Hills
Pan American Petroleum Co.	6	31	25	3-B	Elk Hills
Pan American Petroleum Co.	2	31	24	14-F	Elk Hills
A. W. Hunt	2	29	28	5	Kern River
A. W. Hunt	2	29	28	6	Kern River
Revenue Oil Co.	4	29	28	22	Kern River
Union Oil Co.	11	28	27	6	Kern River
Associated Oil Co.	34	31	23	93	Midway
Brookshire Oil Co.	24	31	22	9	Midway
C. C. M. O. Co.	26	31	22	6	Midway
C. C. M. O. Co.	9	32	23	8	Midway
C. C. M. O. Co.	22	31	22	20	Midway
Formax Oil Co.	36	32	23	1	Midway
Honolulu Cons. Oil Co.	6	32	24	69	Midway
Honolulu Cons. Oil Co.	6	32	24	39	Midway
Honolulu Cons. Oil Co.	6	32	24	11	Midway
Pacific Oil Co.	15	32	24	18	Midway
Pacific Oil Co.	35	31	23	33	Midway
Pacific Oil Co.	13	32	24	1	Midway
Pacific Oil Co.	5	32	24	21	Midway
Record Oil Co.	28	31	23	5	Midway
Tumbador Oil Co.	23	31	22	15	Midway
Union Oil Co.	34	31	23	14	Midway
Republic Petroleum Co.	6	11	23	8	Sunset
Tannehill Oil Co.	34	12	24	23	Sunset
P. Welch	13	11	23	2-GP	Sunset
LOS ANGELES COUNTY:					
Barham No. 1	19	4	12	1	Long Beach
Dabney Oil Synd.	29	4	12	11	Long Beach
Dabney Oil Synd.	29	4	12	12	Long Beach
Dabney Oil Synd.	29	4	12	13	Long Beach
Hagar & Deniston	19	4	12	1	Long Beach
Havenstrite & Baker	29	4	12	1	Long Beach
Henderson Petroleum Synd.	20	4	12	1	Long Beach
Henderson Petroleum Synd.	20	4	12	Dodge 1	Long Beach
Hub Oil Co.	19	4	12	1	Long Beach
Metropolitan Petroleum Corp.	30	4	12	1	Long Beach
Mutual Oil Assn.	30	4	12	1	Long Beach
Painted Hills Oil Assn.	19	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	1	Long Beach
Progressive Burnett Oil Co.	30	4	12	1	Long Beach
Shell Co.	30	4	12	2	Long Beach
Shell Co.	29	4	12	4	Long Beach
Shell Co.	29	4	12	1	Long Beach
Shell Co.	29	4	12	3	Long Beach
Shell Co.	29	4	12	Nesa 2	Long Beach
Shell Co.	29	4	12	2	Long Beach
Temescal Oil Co.	19	4	12	1	Long Beach
Union Oil Co.	30	4	12	5	Long Beach
Western Star Oil Co.	29	4	12	2	Long Beach

Company	Sec.	Twp.	Range	Well	Field
LOS ANGELES COUNTY—Cont'd					
Baldwin Stocker Oil Est.	1	2	12	1	Montebello
Union Oil Co.	2	2	12	1	Montebello
C. C. M. O. Co.	9	4	14	2	Redondo
C. C. M. O. Co.	15	4	14	2	Redondo
General Petroleum Corp.	8	4	14	1	Redondo
General Petroleum Corp.	6	3	11	89-A	Santa Fe Springs
General Petroleum Corp.	6	3	11	90	Santa Fe Springs
General Petroleum Corp.	6	3	11	90-A	Santa Fe Springs
General Petroleum Corp.	6	3	11	79-A	Santa Fe Springs
General Petroleum Corp.	6	3	11	86-A	Santa Fe Springs
General Petroleum Corp.	6	3	11	89	Santa Fe Springs
George F. Getty	5	3	11	1	Santa Fe Springs
George F. Getty	6	3	11	1	Santa Fe Springs
Globe Petroleum Corp.	6	3	11	1	Santa Fe Springs
Industrial Oil Synd.	6	3	11	1	Santa Fe Springs
Leonard Jones	6	3	11	3	Santa Fe Springs
P. M. B. Synd.	6	3	11	1	Santa Fe Springs
Peterson Synd.	6	3	11	1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	2	Santa Fe Springs
Standard Oil Co.	6	3	11	2	Santa Fe Springs
Standard Oil Co.	6	3	11	1	Santa Fe Springs
Jos. B. Turman Oil Synd.	6	3	11	1	Santa Fe Springs
Twin Bell Oil Synd.	6	3	11	3	Santa Fe Springs
Union Oil Co.	6	3	11	9	Santa Fe Springs
Union Oil Co.	6	3	11	4	Santa Fe Springs
Union Oil Co.	6	3	11	10	Santa Fe Springs
White Star Oil Synd.	6	3	11	1	Santa Fe Springs
Fullerton Oil Co.	22	2	12	1	----------
Union Oil Co.	33	3	13	1	----------
MONTEREY COUNTY:					
Rosebrand Petroleum Co.	12	21	9	1	----------
NAPA COUNTY:					
Sugar Loaf Oil Assn.	-------	8	3	1	----------
ORANGE COUNTY:					
Standard Oil Co.	18	3	10	91	Coyote Hills
Amalgamated Oil Co.	34	5	11	4	Huntington Beach
Amalgamated Oil Co.	34	5	11	5	Huntington Beach
Bell of Montebello Oil Co.	35	5	11	6	Huntington Beach
Globe Petroleum Corp.	34	5	11	2	Huntington Beach
International Petroleum Co.	35	5	11	1	Huntington Beach
Jameson Oil Co.	11	6	11	2	Huntington Beach
Mazdah Oil Co.	11	6	11	1	Huntington Beach
Miley Keck Oil Co.	34	5	11	22	Huntington Beach
Olig Crude Oil Co.	2	6	11	1	Huntington Beach
Shell Co.	34	5	11	5	Huntington Beach
Square Deal Synd.	26	5	11	1	Huntington Beach
Standard Oil Co.	2	6	11	13	Huntington Beach
Standard Oil Co.	2	6	11	14	Huntington Beach
Union Oil Co.	34	5	11	2	Huntington Beach
White Behr Petroleum Synd.	34	5	11	1	Huntington Beach
Fairview Oil Co.	4	6	10	2	Newport
Newport Oil and Refining Co.	28	6	10	2	Newport
SANTA BARBARA COUNTY:					
Wm. F. Tobin	Lookout Park			1	Summerland
SAN BERNARDINO COUNTY:					
San Bernardino and Colton Oil Co.	16	1	4	1	----------
STANISLAUS COUNTY:					
Orestimba Oil Co.	34	7	8	1	----------
TULARE COUNTY:					
Kings-Tulare Oil Synd.	19	21	23	1	----------
VENTURA COUNTY:					
Califranco Oil Co.	13	4	18	2	Piru
Santa Fe Petroleum Co.	17	4	18	7	Piru
Schell & Jennings	32	4	18	2	Piru
Oak Ridge Oil Co.	18	3	20	13	South Mountain

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

SILVER LODES OF THE SOUTH FORK MINING DISTRICT, SHASTA COUNTY.

By W. Burling Tucker.

The South Fork Mining District is situated two and a half miles northwest of Igo, and fifteen miles southwest of Redding. The nearest shipping point is Girvan, twelve miles east on the Southern Pacific Railroad.

Topography.

The silver bearing veins occur in a granitic batholith, which lies between the South Fork of Clear Creek, and Andrews Creek, and is about one and three-quarters miles through the base, along the trend of the main fissure systems, northeast and southwest. The elevations, as indicated by the U. S. Geological Survey, range from 1200 feet to approximately 2300 feet. The South Fork drainage empties into Clear Creek a few miles below the Chicago mine.

History.*

Silver ore was first discovered in the South Fork Mining District in 1856. The Chicago Mine, the principal producer of the district, was located in May, 1866, by N. S. and J. B. Batcheler. From 1866 to 1881 over $100,000 worth of ore was taken out of this mine. The first shaft sunk on the Chicago mine yielded a handsome profit. The ore from this mine was mostly silver, although some taken from the original shaft ran as high as $200 per ton in gold. Mr. C. N. Kingsbury, an Igo pioneer who worked in the mine in the early 70's, states that the mine was originally worked to a depth of 180 feet, when excessive water stopped operations.

The ore was hauled by wagon to Red Bluff, a distance of about forty miles, shipped by boat to San Francisco, then transhipped by sailing vessel to Swansea, Wales, for reduction. At a later period Mr. Butterfield operated the Chicago mine for a period of four years, and while the metallurgical losses were heavy with the crude practice then available, it is reported that a good profit was made from the mine. During these operations a steam pump was installed and the ore worked in a fifteen-stamp mill, which was located on the South Fork of Clear Creek. Amalgamation was not successful, and concentration was very faulty because of sliming of gray copper sulphides with which the high grade silver was associated.

---

*M. E. Dittmar, E.M.

In the final operations a depth of 210 feet was reached in the Chicago shaft. Leasers worked the Chicago mine until late in the 90's, but increasing costs of operating at greater depth with crude equipment, and the fall in price of silver finally resulted in the discontinuance of operations. Before this time Mr. William Ireland, Jr., former State Mineralogist of California, became interested in the property. The drifting done on the Chicago lode was evidently considerable, but there is no reliable information as to the actual extent. It was evidently stoped to surface from the stated depth of 210 feet, a distance of about 400 feet southwest of the shaft. According to Mr. Alex Lester, who was the pioneer Wells Fargo agent at Igo during the entire period that the Chicago mine was an active producer, the output was approximately $1,000,000. In 1900 the present long drainage tunnel on the Silver Falls and Chicago Consolidated group of mines was driven into the mountain 3000 feet. This tunnel was driven by the Igo Development Company, and cost $120,000. The burning of the plant, death of the managing director, and low price of silver caused the company to suspend operations.

The other properties in the district worked in the early 70's and 80's were the Big Falls Mine, operated by Mr. Ed Ballou, now known as the Ballou Mine. Here the values were mostly gold.

On Andrews Creek, three miles from Igo, is situated the Crystal Mine, formerly owned and operated by H. Rothwell, first located in 1866. It is stated that ore shipped from this property ran from $100 to $300 per ton in silver, with low gold values.

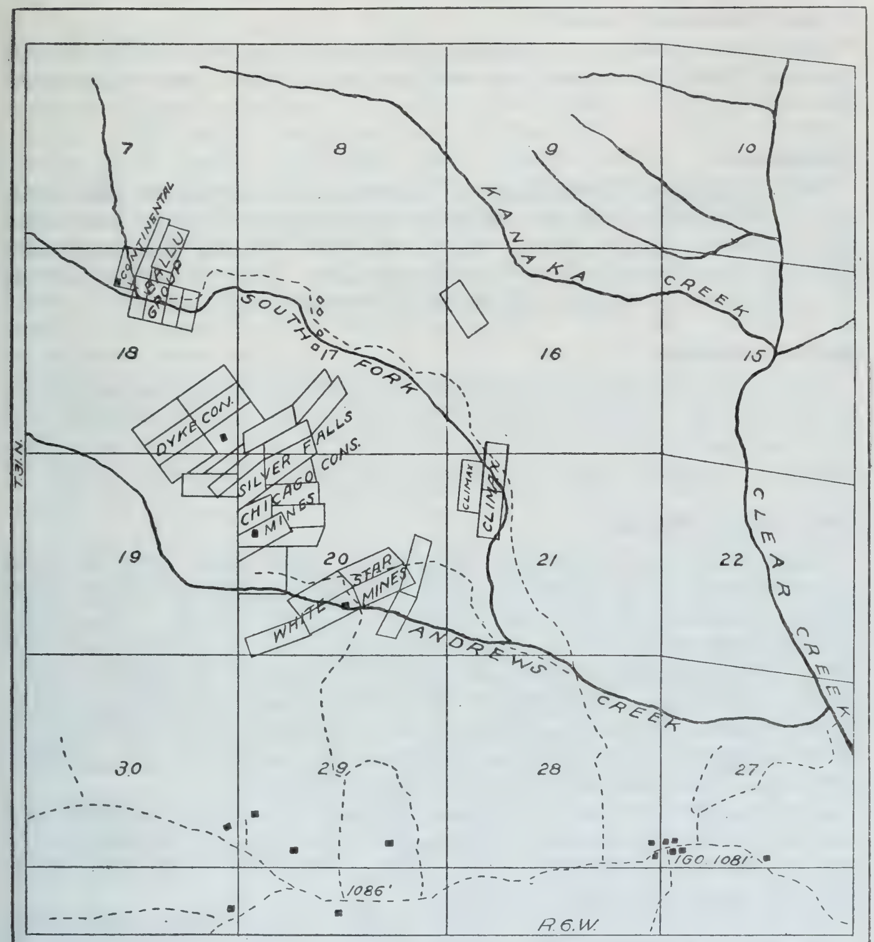
This property is now known as the White Star Group of Mines.

Big Dyke Mine, situated north of the Chicago Consolidated Mines, was discovered in 1866, and next to the Chicago and Crystal Mines was the largest producer in the camp. It is stated that ore shipped from this property ran from $100 to $600 per ton. Acquired by William Dyke and Richter Bros. in 1906. Operated at intervals from 1906 until 1919.

Geology.

O. H. Hershey records the formations, in which the fault fissures occur as batholithic in character. He describes the country rock as light gray, medium textured crystalline, consisting of white feldspar, colorless quartz, dark green hornblende and dark brown biotite, and probably a granodiorite. There is a finer-grained phase, possible gneissic inclusions, dark gray basic segregations and small dikes of pegmatite and aplite. The rock constitutes a fairly large batholith and as the veins all have more or less vertical dips, they may be depended to continue in this granite mass. The veins occupy fissures in the granite. The granite mountain, according to George Bancroft, is a batholith of quartz-hornblende diorite. J. S. Diller, in Redding Folio, maps the nearby areas of like formation, also as quartz hornblende-diorite and makes note of the batholithic structure.

The granodiorite is traversed by a system of northeast and southwest fissures, roughly parallel. Bancroft recognized two sets of veins, one striking N. 45° E., the other N. 58° E.; the dip is generally to southeast at high angles. Near the surface some of these veins show a slight dip to the north, but the average dip is from 75 to 80 degrees southeast. Both walls of the veins have heavy gouge showing some fault movement. The silver-bearing mineral is tetrahedrite associated with galena, small amounts of pyrite, sphalerite and some chalcopyrite, with small amounts of gold. These roughly parallel quartz veins intersect at small angles, both in strike and dip.



SOUTH FORK MINING DISTRICT
SHASTA COUNTY, CAL.

Enrichment has occurred above intersections on the dip, where the convergence points upward. This is illustrated on the map of the Chicago workings, showing different veins and their intersections. The width of the veins varies from 8 to 4 feet. The zone of oxidation is from 10 to 50 feet in depth. Trend of ore shoots is to the northeast.

Water, Timber and Power.

Water and timber are plentiful for mining operations. The Pacific Gas and Electric Company's power line passes within three miles of the district.

Conclusions.

With intelligent development to determine the ore shoots that occur on the intersections of the different vein systems, both on strike and dip, and their general trend, the South Fork Mining District should develop a prominent silver producing area. The principal lack at present is a small flotation plant for treatment of the ores.

Acknowledgments.

The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines in the district, and particularly the personal assistance in the field rendered by Dr. F. M. Archer and Chas. Dozier of Redding, and Arch Wright and Albert Kingsbury of Igo.

Description of Mines.

Silver Falls and Chicago Consolidated Mines has been the most important mine in the district. It is four miles northwest of Igo. The present workings are in Secs. 17, 18, 19, 20, T. 31 N., R. 7 W., on the southwestern slope of the granite mountain, at an elevation of 1400 feet. The property is owned by Dr. F. M. Archer of Redding, California. Holdings consist of the following claims: Pillchunck, Union, Cold Spring, Richmond, Madison, and Chicago, held under U. S. mineral patents; Fraction No. 1, Fraction No. 2, Fraction No. 4, Metal, Amy and Batholith, by location, totalling 220 acres.

Developments consist of the main Chicago shaft which was sunk to a depth of 210 feet on the Chicago-Madison vein, and stoped to the surface 400 feet southwest of the shaft. Production from these workings was approximately $1,000,000.

On the Richmond claim, 3 shafts, known as the Wright shafts, were sunk on the Richmond lode system. No. 1 shaft is 30 feet deep; 40 feet northeast of this shaft is No. 2 shaft which was sunk to a depth of 80 feet; and 60 feet northeast of the latter is No. 3, having a depth of 20 feet. A drift was driven from No. 1 shaft to No. 2. The vein in these workings is said to be from 10 inches to 2 feet wide. When work was suspended in No. 2 it is reported that there was 12 to 18 inches of good ore in the bottom. Ore mined from these workings was sorted up to 400 ozs. per ton and shipped. Samples taken from ore in place along the strike of the vein between these shafts ran from 10 ozs. to 163 ozs. in silver per ton. The ore shoot is 120 feet long, average width 12 inches. These shafts are approximately 2150 feet north of the portal of the main crosscut tunnel, the surface being 540 feet above the tunnel level.

At the southwest end of the Chicago claim a crosscut tunnel was driven 50 feet, cutting the main Chicago-Madison vein, and a drift run northeast 75 feet and stoped out to the surface. The vein is 12 inches to 2 feet wide, carries high values in gold, and samples taken from the face of the drift ran $26 per ton in gold. These workings are 550 feet above the tunnel level. In 1900 a crosscut tunnel was driven 3000 feet in the mountain, at an elevation of 1400 feet, giving a depth of 600 feet below the outcrop of the Chicago vein. This tunnel cut 36 fissure veins as identified and mapped by George Bancroft. Quite a number of these veins are little more than seams or fractures in the granite. The most prominent may be classified as the Pillchunck, Union, Cold Spring, Richmond and Chicago-Madison lode systems. The Pillchunck, cut in the tunnel at a depth below the surface of 261 feet, was the first vein of any consequence. A drift was driven on this vein about 100 feet northeast, but not driven far enough to cut the ore shoot developed on the surface. The vein shows some quartz with heavy gouge on both walls. Further in the mountain the Union vein system was cut 384 feet below the surface. The next exposure of importance is on veins 26 and 27. The crosscut here obtains a depth of 540 feet vertically below the surface and then extends northeasterly 200 feet as a drift on 27. The tunnel then turns due north and is continued as a crosscut 600 feet farther to what is known as vein No. 36, which was drifted on 100 feet.

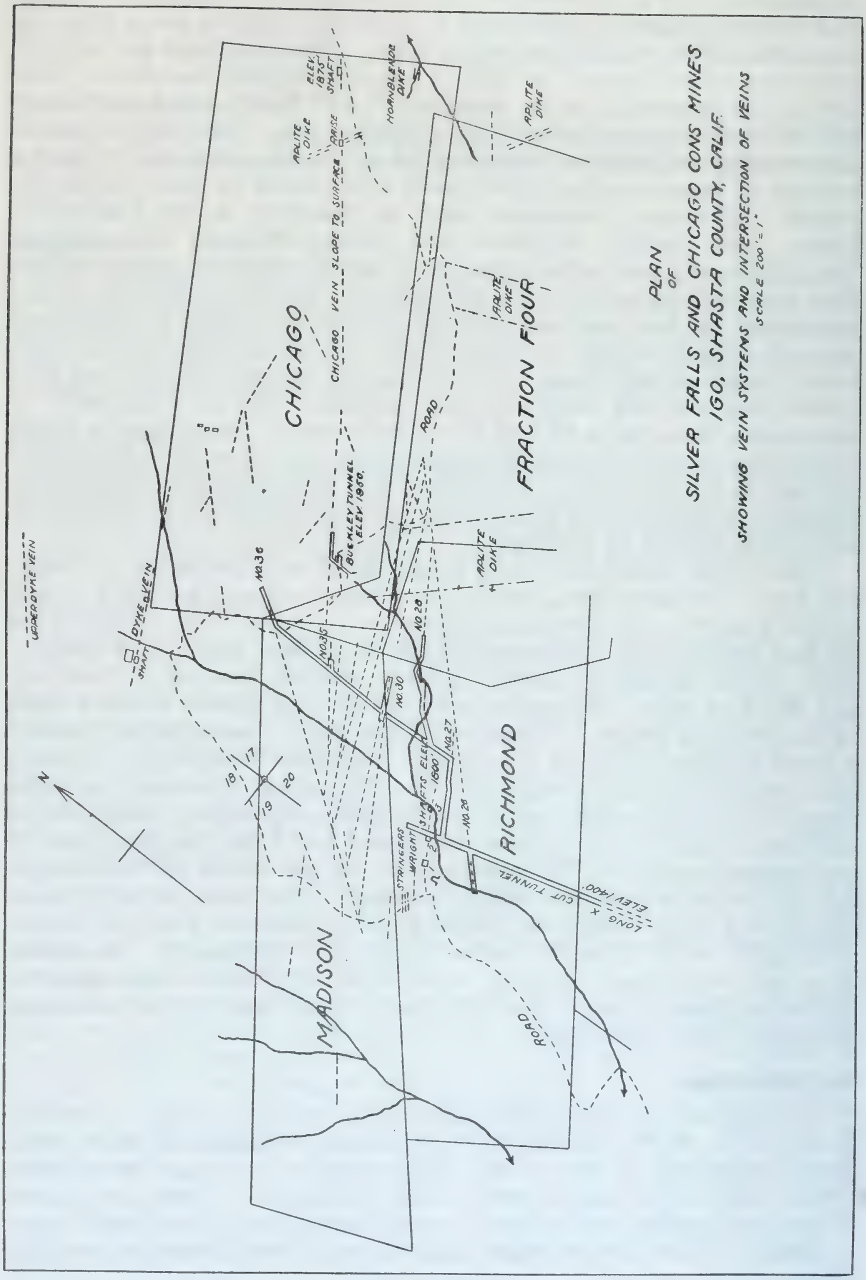
Vein No. 28, which was cut in this crosscut, was drifted on northeast 225 feet. In this drift a shoot of ore was developed having a length of 210 feet, the vein averaging 12 inches in width. Ore stoped about 20 feet above drift. Shipment made from this stope in February, 1910, to the Mammoth Smelter, without sorting, assayed 17.7 ozs. ag. and $0.83 in gold. Shipment included all vein matter between walls in the five-foot fissure. Veins No. 30 and No. 35 were drifted on only a short distance. No. 35 is evidently the main Madison and Chicago lode, although it may be vein No. 30. This system apparently includes veins 28 and 30 intersecting on the northeasterly strike. Vein No. 30 intersects veins 35 and 36 several hundred feet from the tunnel on the southwesterly strike. The intersection of the veins on both strike and dip is important in forming ore shoots. See map, showing intersection of vein systems. Ore shoots form in lenticular lenses of quartz, varying in width from 10 inches to 4 feet. Equipment: Blacksmith shop and compressor building, bunk house; 3000 feet 3-inch pipe for airline in place in main crosscut tunnel; blower and 8-inch ventilation pipe line; 3000 feet of pipe.

Big Dyke Mine.

It is situated 4 miles northwest of Igo, in Secs. 17, 18, 19 and 20, T. 31 N., R. 6 W., adjoining the Chicago Consolidated Mines Company's property on the north. The property is owned by William Dyke, John and Frank Richter of Igo, California. There are six contiguous lode claims totalling 120 acres; known as the Big Dkye Group.

Claims: **Edna, Little Dyke, Alta, Helen, Dyke Extension and Big** Dyke.

Development has been confined to the Big Dyke vein on the Big Dyke claim.



PLAN
OF
SILVER FALLS AND CHICAGO CONS MINES
IGO, SHASTA COUNTY, CALIF.
SHOWING VEIN SYSTEMS AND INTERSECTION OF VEINS
SCALE 200' = 1"

A series of roughly parallel veins in the granodiorite, strike N. 60° E., and dip slightly to the southeast from the vertical. The Big Dyke fissure is about 3 feet in width with a filling of quartz and altered granite having heavy gouge on both walls. This filling is heavily mineralized with argentiferous galena, tetrahedrite, some pyrite, sphalerite, some native silver and small amount of gold. The veins are oxidized and leached to a depth of 20 to 50 feet.

Developments: At an elevation of 2000 feet a vertical shaft was sunk to a depth of 153 feet on the vein. On the 100-ft. level the vein was drifted on 165 feet to the northeast, and 20 feet to the southwest. Some stoping was done on the ore shoot on this level, and a shipment made to the Mammoth Smelter at Kennett is said to have averaged 300 ozs. per ton in silver. About 50 feet below this level a drift was run 65 feet northeast on the vein. About 100 feet below the collar of the shaft there is a crosscut tunnel 200 feet long which intersects the vein on the 100-foot level, 100 feet northeast of the shaft. Southwest of the shaft a tunnel, now caved, was driven 200 feet on the vein. It is reported that the ore in the shaft has a width of 12 to 36 inches; assays range from $20 to $400 per ton.

Equipment: 15-horsepower gasoline hoist, 20-horsepower air compressor and pumps. Idle.

White Star Silver Group of Mines (Formerly known as Crystal Mine).

It is situated three miles northwest of Igo, on Andrews Creek, at an elevation of 1250 feet. The property is owned by Thomas Kingsbury, Albert Kingsbury and J. D. Hubbard of Igo, California. Holdings consist of the following claims: J. D., White Star, North Star, Wood, Contact, Contact Fraction, Henry Ford and Henry Ford Extension, totalling 160 acres. These claims are located in Sec. 20, T 31 N., R. 6 W.

Three parallel veins cut the granodiorite, and are about 20 to 40 feet apart. Strike northwest and southeast, dip 80 degrees southeast.

The ore carries native silver, tetrahedrite, sphalerite, small amount of pyrite, chalcopyrite, and some gold associated mostly with the pyrite.

Developments: Outside of a number of prospect shafts and short tunnels, all work has been confined to the middle vein. A crosscut tunnel has been driven N. 50° W., 320 feet, which cut the three veins at a depth of 90 feet below the surface. No. 1 vein was cut 150 feet from the portal of the tunnel, and drift run 50 feet to the northeast and 35 feet to the southwest, and was stoped about 15 feet above the drifts. Vein has a width of 12 inches to 3 feet. Twenty feet farther on it cut No. 2 vein, which was drifted on 100 feet to the southwest, and 60 feet to the northeast. On this level, 20 feet to the southwest, a raise was run to the surface on ore. The ore extracted from this raise is said to have carried high gold values, and it was stoped to the surface. In the northeast drift on this vein, at a distance of 40 feet from the crosscut tunnel, an upraise was made for 40 feet, then the vein was drifted on 40 feet to the southwest and connected with the shaft from the surface. The main crosscut tunnel continues 160 feet, where it cut No. 3 vein, which has a width of 2 feet, but no development has been done on this vein. At 10 feet northeast of the main crosscut tunnel, a winze has been sunk 50 feet and a drift driven on the vein

100 feet northeast. No. 1 and No. 2 veins intersect northeast of the winze on this level forming an ore shoot 60 feet in length. Width of the vein is from 2 to 5 feet.

A shipment of ore made from this shoot to the Selby Smelter on April 27, 1922, ran 150 ozs. in silver, 0.2 oz. gold, 1.8% lead, and 13.3% zinc.

The property has been operated off and on by Mr. Albert Kingsbury, who has shipped about $2,000 worth of ore to smelters. The general run of ore from this mine will average from $10 to $50 per ton.

Equipment: Consists of cars, handpump, blacksmith shop and tools. Development work in progress.

Climax Mine.

It is situated 3 miles northwest of Igo, on the South Fork of Clear Creek, in Secs. 16-21, T. 31 N., R. 6 W., elevation 1400 feet. Holdings consist of three claims known as Climax, South Climax and West Climax, totalling 60 acres. The vein occurs on a contact of granite and meta-andesite. Strike N. 40° E., dip 45° E. Developments consist of a 150-foot shaft, drift 110 feet east on vein and 75 feet west, and 170-foot tunnel. Vein is from 10 to 25 feet wide, carries values in gold, silver, and shows pyrite, sphalerite and galena in quartz. Property idle.

Continental Mine.

It is 6 miles northwest of Igo, on the South Fork of Clear Creek, at an elevation of 2200 feet. Holdings consist of 7 claims, in Secs. 7 and 18, T. 31 N., R. 6 W., and adjoin the Ballou Group of claims, on the west. There are two veins on this property, one which strikes N. 10° E.; the other striking N. 45° E., and dipping 80° S.E. Country rock is granodiorite. On the slope of the ridge north of the South Fork of Clear Creek, a crosscut tunnel has been driven N. 50° W., intersecting the vein, which has a course of N. 45° E. The vein has been drifted on 200 feet northeast. This vein is 8 inches to 3 feet wide and the fissure is filled with quartz and altered granite, with gouge on both walls. The fissure is heavily mineralized with argentiferous galena, pyrite, tetrahedrite, sphalerite, and native silver, and carries a small amount of gold. The vein is oxidized and leached to a depth of 20 to 50 feet. This tunnel gives a depth of 200 feet vertically below the outcrop. Near the top of the ridge, about fifty feet below the outcrop, a tunnel was driven on the vein, extent not known and now caved, but probably 200 feet. At the mouth of the tunnel there is a shaft. On the surface the outcrop of quartz is 8 to 10 feet wide and can be traced for at least 3000 feet. In the 80's the operators had a 6-stamp mill on the South Fork, where ore was milled from these upper workings. Equipment consists of cars, track and blacksmith shop. Property idle. Only assessment work done. Owners: V. V. Apperson and associates of Willows, California.

Manzanita Mine. (Ballou Group of Mines.)

This group of mines is situated 6 miles northwest of Igo, in Secs. 7 and 18, T. 31 N., R. 6 W. The workings are on the north slope of the ridge, northeast of the South Fork of Clear Creek, at an elevation of 2300 feet. Holdings consist of 5 claims, namely: Hope, Sulphide, Manzanita, Greater Falls Series, Plus Series, all held under U. S. mineral patents, totalling 100 acres. The property is owned by May V. Ballou of Redding, California. These claims were located December 13, 1880. A series of parallel quartz veins, whose general strike is N. 20° E., and dip 80° E., traverse the granodiorite. On the Manzanita claim, at an elevation of 2300 feet, a crosscut tunnel was driven 30 feet west, cutting a vein which strikes N. 20° E. This vein was drifted on to the south 200 feet. The vein has a width of 8 inches to 2 feet, but the pay ore occurs in a seam of oxidized quartz near the footwall that is heavily stained with iron. This seam carried high gold values. The quartz carries gold, and some pyrite. This tunnel is only about 75 feet below the surface and in the oxidized zone and probably with greater depth one may expect to encounter silver-bearing ores, as in the rest of the district.

There are seven tunnels and one shaft on the property. Tunnel on the Hope claim is 700 feet long. On the Sulphide claim there is a tunnel 300 feet in length, besides a number of shorter tunnels, from 50 to 100 feet in length. Property idle.

DRY PLACERS OF SOUTHERN CALIFORNIA.

By Chas. S. Haley.

From the time of the days of the Mexican colonies—when Alta California, as it was then called, was a province of the Spanish crown—gold has been won from the dry placers of the desert. The Indians in the days of the padres used to bring in gold to the missions, which was laboriously recovered from the desert washes by the crudest of methods. Unfortunately, however, there is no reliable record of production until comparatively modern times; but we know that in total it amounted to many millions of dollars. Since the American occupation of California, we have somewhat of a record, however; and we know of districts which have produced from a hundred thousand to two millions of dollars—all won by hand methods and mostly by dry washing.

For this reason, it seemed to the present investigator, in preparing a volume on the placer gold resources of the State, that there might still be a possibility of obtaining an economic return from these placers by the application of large scale working methods; and that it might in some cases justify the bringing of water for some distance to cover the ground.

However, the results of this investigation—which has covered every district of importance in the desert—have, on the whole, been very disappointing; and the writer is forced to the conclusion that these placers have already been exploited by the only practical means—the Mexican with his little hand operated bellows and hopper. The reasons for this conclusion will be given herewith.

From the standpoint of geological history, the district south of the Tehachapi has been distinctly different from the region of the great valley to the north. The ranges of subsidence and elevation have been much less during Tertiary and later times. During the Ione and later transgressions which covered the foothills of the western slope of the

Sierras and the Coast Range, this region was comparatively quiescent. For this reason, it may be assumed that the topography and to some extent the climatic conditions of this region during the time at which changes were taking place to the north, did not vary greatly.

This fact leads to a vital difference in the manner and amount of deposition of the gold in the desert channels—so far as it occurs along the line of channels. Whereas in the north we have a primary concentration from the erosion of the metamorphics and intrusives of the Sierras, to be followed later by a reconcentration of the values in the Tertiary streams by the present, or Quaternary drainage running in many cases normal to the older. In the region of the desert we have an entirely different condition, and one not nearly so favorable to the concentration of gold in large quantity and persistent amount.

In the south, the drainage during Tertiary times evidently did not greatly vary from the present lines. Roughly, practically all of the deposits on which stream action had the slightest bearing may be classed along the drainage lines of ancient streams whose courses follow the general direction of the modern ones, such as they are. In some cases, the ancient ones seem larger than those of the present day—in other cases smaller.

In San Diego County, we have a course which, commencing in the Cuyamaca Mountains, near Julian and the Banner district, runs down through Ballena via Hatfield and Coleman creeks—which have crossed it and caused local concentration—down through Ramona and the San Vicente region, and finally empties into the ocean somewhere round La Jolla. This region is not of economic importance, as the values were very spotty, according to the records of the districts, and facilities for working are limited to a very short season of the year.

East of this, in Imperial County, we have either local erosion deposits, like that in the Borego country—which is said to average about fifteen cents a yard—or the deposits in the Chuckawalla basin, the Chocolate Mountains, the Eagle Range, and the country north and east of Desert Center. These were all more or less tributary to the drainage system of the Colorado, which is probably one of the oldest rivers on the western slope. On the Colorado itself, or near it, we have the Potholes, at Laguna; the Picacho Basin; and other deposits in the Blythe-Parker-Ehrenberg region. These were all investigated by the writer; and his conclusion is that, although a recorded production running into the millions has come out of them, little remains of interest to either large capital or the small miner.

The gravel, or eroded material, was very spotty and seemed to carry the values in the subangular stuff at some distance above bedrock; and any pumping scheme which might be used to get water would be so costly and cumbersome that the ground will never pay it back. The Mexican with his little portable machine and lack of overhead in moving from gulch to gulch where the greatest concentrations were, had the only feasible system. The Picacho and Laguna deposits are disintegrated schists and slates for the most part, containing quartz stringers from which the gold has come. In both cases the erosion caused by the Colorado River at the base of a low range of hills has resulted in the accumulation of this material. The river wash itself does not carry much value, but the disintegrated matter above carries it; and the erosion of present day gulches has resulted in local concentrations which were worked by the Mexicans.

Coming down from the Owens Lake country, along the eastern base of the Sierras, was an ancient channel which may have come through Red Rock canyon, where it was joined by another, flowing eastward from Tehachapi by way of Jawbone canyon. Turning easterly, its course can be traced by way of Goler and Summit Diggings. From here on, it may have gone by way of Copper Canyon to Long Range and Coolgardie, there to lose itself near Barstow in the present channel of the Mojave. Another portion of this system runs from the Stringer district down through St. Elmo wash, where it is still being worked in a small way by hand dry washers. Another comes down Goler wash, in the Panamints.

This channel or system of channels, is one of the best known in the south, and illustrates, by its physical characteristics, a point which strikes the writer very forcibly in its bearing on the possible economic operation of these gravels.

As a rule, the stream gravel, which consists of well rounded boulders of crystalline rocks from the Sierras, carries no value at all. Wherever it crossed a belt of metamorphics containing quartz stringers, or any body of olivine-bearing, or other basic rocks; by local erosion it produced, in connection with the heavy cloudbursts which swept down the gulches intermittently, local concentrations of gold. As a result, at Goler one can notice that the shingling of the washed material is transverse to the general direction of the course of the deposits. Heavy gold is found near the tops of the ridges and from thirty to sixty feet above bedrock, and on local false bedrocks of clay and disintegrated volcanics. At Summit Diggings, intensively worked on account of its shallow depth during early days, a scheme is now proposed of bringing water twelve miles to cover the deposit. The same thing is proposed at Coolgardie, with a fifteen-mile water system. As the concentrations have long been worked out by hand methods, and the general body of the deposits will only run from fifteen to sixty cents a yard, it is considered a waste of time and money to carry out either of these ideas.

In Lytel Creek, along the line of the Santa Fe, there was a local concentration from stringers in the granite. This has all been worked out. A little water was available here.

The last of these very interesting systems consists of a channel which, coming down from Placerita canyon, near Newhall, with another branch which headed above Bouquet canyon, crossed into San Francisquito and came down somewhere below Piru, to be joined by another course which came from Lockwood by way of Piru canyon.[1] It was impossible to work out the definite course of this system, but the above is a fair approximation. This was much worked in the early history of Los Angeles and Ventura counties; but as even the Chinamen gave it up as no longer affording them a living, it would not be advisable for a white man to try it. The values appeared to be concentrated on the points of the present hills and in the gulches. Quite a little water was available for working this system.

---

[1] In preparing this article, the San Gabriel and the Bear and Holcomb Valley deposits have been omitted, as they do not come under the head of dry, or semi-dry placers.

It must be remembered, in estimating the gross production of this, as well as other regions in this part of the country, that a large part of the work was done when wages averaged about a dollar a day, in times of industrial depression. Many men, making a bare living at best, preferred to be their own masters while doing it; and the aggregate of all their earning presents an impressive figure. Considering the length of time involved, and the number of men employed, it is no wonder that the aggregate amount, even from very poor diggings, was large.

One final point that has impressed the writer, and with particular force, is the total and absolute failure of air separation processes when applied on anything larger than a hand scale. Two monuments to this failure still stand in mournful state—one at Goler, and the other at Coolgardie. Limited capacity and imperfect separation are the main reasons. A machine which will work on a laboratory scale with material which has been dried on a hot plate, certainly will not be a success when applied to the general run of desert material—especially after a shower has moistened the ground. The material simply balls up on the canvas tables. Further, machines of this character are so cumbrous that they lose the chief advantage of the hand machine—its ability to be transported from one spot, or concentration of gold, to another as soon as the pay has been worked out.

The most successful method of handling this material, in the judgment of the writer, is one which was tried out in the Randsburg district some time ago. It consists in the use of a very little water and the constant saving and return of the same for rewashing. This venture 'broke even' on four dollar ground when water cost a quarter cent a gallon and had to be hauled five miles. The cost of one miner's inch, which in the north country is supposed to move one yard of ground under proper conditions, would be thirty-six dollars a day, at this rate, if the water were not returned.

In the method referred to, a sluice about seven feet long and fourteen inches wide, is given a head motion by an eccentric, and driven by a two-horsepower gas engine. The sluice has a false bottom, with holes immediately behind the hungarian riffles. The material is wheeled and shoveled in, after boulders have been screened out. The water carries out the fines on about a twelve-inch grade into a wheelbarrow which stands over a pit. The wheelbarrow is punched full of holes, and the water is drained into the pit from it. It is then pumped back by a centrifugal pump, which is run by the same gas engine from a countershaft, through the false bottom, where it jets up behind the riffles to perform its service in carrying the material through the sluice again. The only loss of water is through evaporation and absorption; the riffles are always kept open by the uplifting jets of water; and the concentrating motion of the eccentric head makes a very effective jig of the whole affair.

To the writer's mind, where any water at all is available, this process of separation has all the air processes on the market completely distanced; but it can only be applied on a small scale to ground which will run from four dollars up—and in his experience there is so little of the desert placer which will run this amount per yard that it is practically negligible.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Oil Field Map No. 5, Whittier-Fullerton, including Whittier, West Coyote and Montebello Fields. Revised to May 20, 1922.
Oil Field Map No. 7, Sunset Oil Field. Revised to May 1, 1922.
Oil Field Map No. 13, Kern River Oil Field. Revised to May 25, 1922.
Oil Field Map No. 14, Coalinga Oil Field. Revised to May 15, 1922.
Oil Field Map. No. 15, Elk Hills Oil Field. Revised to June 1, 1922.
Summary of Operations, California Oil Fields, April, 1922. Vol. 7, No. 10.
Mining in California, June, 1922, (Monthly) Vol. 18, No. 6.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XV, State Mineralogist	1
Report XVII, State Mineralogist	18
Mines and Mineral Resources of Colusa, etc.	1
Mines and Mineral Resources of Del Norte, etc.	3
Mines and Mineral Resources of Fresno, etc.	1
Mines and Mineral Resources of Butte, etc.	2
Mines and Mineral Resources of El Dorado, etc.	4

Publications	Number distributed
Mines and Mineral Resources of Los Angeles, etc.	1
Mines and Mineral Resources of Monterey, etc.	2
Mines and Mineral Resources of San Bernardino, etc.	2
Mines and Mineral Resources of Nevada County	5
Mines and Mineral Resources of Plumas County	1
Bulletin No. 6, California Gold Mill Practices	5
Bulletin No. 23, Copper Resources of California	1
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	5
Bulletin No. 46, Index of Mining Bureau Publications	1
Bulletin No. 50, Copper Resources of California (Revised)	2
Bulletin No. 72, Geologic Formations of California	8
Bulletin No. 75, United States and California Mining Laws	30
Bulletin No. 76, Manganese and Chromium in California	2
Bulletin No. 78, Quicksilver Resources of California	5
Bulletin No. 85, Platinum Resources of California	6
Bulletin No. 86, California Mineral Production for 1918	1
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	84
Mining in California (Monthly), Vol. 18, No. 5, May, 1922	2400
Summary of Operations, California Oil Fields (Monthly), April, 1922, Vol. 7, No. 10	2600
County Maps and Registers of Mines	5
El Dorado Forest Map	3
Placer Forest Map	2
Shasta Forest Map	3
Sierra Forest Map	3
Siskiyou Forest Map	3
Tuolumne Forest Map	1
Inyo Geological Map	1
Tuolumne Mineral Map	2
Forest Map, Unmounted	1
Forest Map, Mounted	1
Geological Map of California, Mounted	10
Map Accompanying Bulletin No. 89	28
Plumas Mineral Map	2
Oil Field Maps	475

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 716 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

California produces commercially at least fifty different mineral substances, with a total annual value of nearly $250,000,000. There are several thousand operating properties including mines, quarries, oil and gas wells, mineral springs, salt works, gravel pits, mills and smelters.

Some data relative to the 1921 production has been given in 'Mining in California', beginning with the April issue, and additional substances are covered herein. It is hoped that the completed figures and final summaries may be ready for publication in the August issue of this bulletin. Although over six months have elapsed since the close of 1921, there are still a few operators who are delinquent in their reports. Statistics lose much of their value if late; and the tardiness of only a few prevents early publication of the data. We respectfully urge promptness upon all those interested in the development of California's mineral resources.

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV, XV, XVII. Bulletins 16, 32, 63, 69.

Asphalt was for a number of years accounted for in reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

The production of refinery asphalt, from 16 plants in California, amounts annually to over 250,000 tons, worth approximately $2,500,000. California leads all other states of the Union in such production, as her crude oils are almost entirely of asphaltic base.

DOLOMITE.

Bibliography: Reports XV, XVII. Bulletin 67.

Previous to the 1915 report dolomite was included under limestone. Limestones are frequently more or less magnesian-bearing, and a chemical analysis is often necessary to definitely decide as to whether they are calcite or dolomite; the latter standing intermediate between magnesite ($MgCO_3$) and calcite ($CaCO_3$). Since dolomite, as such, has been found to have certain distinctive applications, we have given it a separate classification.

An important part of the tonnage being shipped is utilized as a refractory lining in the bottoms of open-hearth steel furnaces, as a substitute for magnesite. A portion is used for its carbonic acid gas (CO_2), and part for its magnesia. We are also informed that some calcined dolomite has been used by the paper mills. As dolomite contains the proper proportions of lime and magnesia, it can replace an artificial mixture of calcined limestone and magnesite in the sulphite process of manufacture of paper from wood pulp. Dolomite is also sometimes used as a flux in metal smelting.

The dolomite production in Inyo County is utilized for its CO_2 by the chemical plants on Owens Lake, in the manufacture of soda ash and bicarbonate from the waters of the lake. The Tuolumne County material is burned for the preparation of a dolomitic lime.

The production of dolomite for the year 1921 amounted to 31,195 tons, valued at $99,155, and came from a total of 7 quarries in 5 counties, distributed as follows:

County	Tons	Value
Inyo	22,112	$49,073
Monterey	2,500	8,750
San Benito, San Bernardino, Tuolumne*	6,583	41,332
Totals	31,195	$99,155

*Combined to conceal output of a single operator in each.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
Totals	168,061	$506,826

FELDSPAR.

Bibliography: Reports XV, XVII. Bulletin 67. U. S. Bureau of Mines, Bulletin 92.

Feldspar was produced by eight operators in three counties during 1921, to the amount of 4349 tons, valued at $28,333.

Feldspar production began in California in 1910. The mineral is a constituent of many rocks, but can only be commercially produced from pegmatites where the crystals are large and quite free from impurities. The open-cut quarry method of mining this material is commonly used.

Manufacturers of enamel wares and pottery buy most of the better grades of feldspar produced. Small quantities are used in the manufacture of glass and scouring soaps, and the more impure material is used as chicken grit, in making various brands of roofing, and in other ways. Various experiments have been made with the potash feldspars in the attempt to extract their potash content for use in fertilizers. The most successful of these has been accomplished through the medium of cement manufacture, and recovery of the potash as a by-product.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

The most important recent developments in feldspar deposits in California have taken place in San Diego and Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important districts are near Lakeside and Campo in San Diego County, and near Lakeview, Murrietta, and Elsinore, in Riverside County. For 1921, some production was also reported from San Bernardino County; but none was reported from Monterey and Tulare counties.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value
1910	760	$5,720
1911	740	4,560
1912	1,382	6,180
1913	2,129	7,850
1914	3,530	16,565
1915	1,800	9,000
1916	2,630	14,350
1917	11,792	$46,411
1918	4,132	22,061
1919	1,272	12,965
1920	4,518	26,189
1921	4,349	28,333
Totals	39,034	$200,179

FULLER'S EARTH.

Bibliography: Reports XIV, XVII. Bulletin 38. U. S. Bureau of Mines, Bulletin 71.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. Like all other clays, fuller's earth is a hydrous aluminum silicate, but usually contains a higher percentage of water of composition than most clays. This water is not an essential factor in the bleaching properties of all fuller's earths, as some bleach fully as well after it has been driven off as before, and others lose much of their bleaching power when this water is removed.

All fuller's earths which have been found valuable for bleaching purposes show a distinctly so-called 'acid reaction.' (If a sample is touched to neutral litmus paper the paper will be turned red). Chemical analyses are now well understood to be no criterion in determining the classification of a given clay as 'fuller's earth.' *The final determination is a commercial one as to its capacity for absorbing basic colors and removing these colors from solution in animal, vegetable or mineral oils, also from water.*

> [1]"The Shipping Board's Inquiries also brought out the interesting information that only domestic fuller's earth is used for the refining of mineral oils. There appears, on the other hand, to be a difference of opinion as to the suitability of the domestic earth for use in refining edible oils. Some of the larger users of fuller's earth, anticipating a shortage of imported material, began early in the war to experiment with domestic earths in refining edible oils and fats, with results so satisfactory that they became independent of imported earth. Others stated that they had experimented with every known domestic earth, but had not found one that completely met the requirements to supplant the imported earth. The requirements of a good earth for refining edible oils are (1) that it shall bleach well and that the oil shall not revert to its original color; (2) that it shall filter well and not cake badly; (3) that it shall leave no permanent disagreeable taste or odor; (4) that the retention of oil in the spent earth shall be small; and (5) that there shall be no spontaneous ignition either in the press or in the waste piles. Those who use the imported earth claim that it is standard in all of these requirements, and that the domestic earth is deficient in one or more of them. Such a defect as inability to bleach well appears to be inherent in some domestic earth, and can not be remedied by treatment. Other defects, such as the taste or odor left by the earth, which is the most frequent objection urged against the domestic material, may possibly be overcome by treatment. Another serious fault charged against the American earth is that it retains a greater proportion of oil than the English earth, which means a direct loss in production; also that it clogs the filter presses more, so that they require more frequent cleaning, which causes further decrease in production. It is also charged that domestic earth is more subject to spontaneous combustion."

In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates.

Production has mainly come from Calaveras and Solano counties. Deposits have also been found in Riverside, Fresno, Inyo, and Kern counties. Experiments are being conducted by some of the large oil refiners, with clays of the montmorillonite and halloysite group ('rock soap') to determine their suitability, or efficacy as a substitute for fuller's earth in the refining of petroleum products. Deposits of this class of material have been exploited during the past three years in Inyo, San Bernardino, and San Diego counties, and occurrences have been noted in several other counties of California.

The production of 1185 tons, valued at $8,295, here credited to 1921, as 'fuller's earth' is in reality a colloidal clay of the montmorillonite class ('bentonite', 'otaylite', 'elkonite', 'shoshonite', are merely local names arbitrarily applied to varieties of this mineral found in a given locality). Because it was used for clarifying and filtering processes, we have placed it, for the purposes of this statistical report, under the 'fuller's earth' heading. As noted above, the final determination as to what constitutes a fuller's earth is a commercial one.

---

[1] Middleton, Jefferson, Fuller's Earth in 1918: U. S. Geol. Surv., Min. Res. of U. S. 1918. Part II, p. 136. 1919.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value
1899	620	$12,400
1900	500	3,750
1901	1,000	19,500
1902	987	19,246
1903	250	4,750
1904	500	9,500
1905	1,344	38,000
1906	440	10,500
1907	100	1,000
1908	50	1,000
1909	459	7,385
1910	340	3,820
1911	466	5,294
1912	876	$6,500
1913	460	3,700
1914	760	5,928
1915	692	4,002
1916	110	550
1917	220	2,180
1918	37	333
1919	385	3,810
1920	600	6,000
1921	1,185	8,295
Totals	12,381	$177,443

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV, XVII. Bulletins 37, 67. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149-153, 331-380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain during the past ten years. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed in a small way. The higher figure of the year 1920 was due to shipments of quartz crystals from Calaveras County and Iceland spar from Modoc County sold for optical purposes, which use demands material of gem quality and free from flaws. The 1921 yield was in smaller amount.

The following table shows the production, by counties, of rough, uncut gem and jeweler's materials during 1921:

County	Value	Kind
Butte	$331	Diamonds and Californite.
San Diego	1,405	Tourmaline, quartz crystals, beryl, spessartite garnet.
Los Angeles	*9,218	Garnets.
Modoc		Optical Iceland spar.
Riverside		Quartz crystals.
San Bernardino		Blue chalcedony
Sonoma		Chalcedony.
Total value	$10,954	

*Combined to conceal output of a single operator in each.

Varieties of California Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado

County; French Corral, Nevada County; Cherokee Flat and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County. One stone weighing 1.85 carats was found in Morris Ravine, near Cherokee, in 1920.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green; also a blue tourmaline has been found.

One of our California gem stones, *benitoite,* has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of vesuvianite, and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purpose, its value being included in the marble figures.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1912	$23,050
1901	40,000	1913	13,740
1902	162,100	1914	3,970
1903	110,500	1915	3,565
1904	136,000	1916	4,752
1905	148,500	1917	3,049
1906	497,090	1918	650
1907	232,642	1919	5,425
1908	208,950	1920	36,056
1909	193,700	1921	10,954
1910	237,475		
1911	51,824	Total	$2,144,492

GOLD.

Bibliography: State Mineralogist Reports I to XVII (inc.). Bulletins 36, 45, 57. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement during the past two years, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska.

The increases in costs of all supplies, labor, and transportation beginning in 1915 made it increasingly difficult in the period following for the gold miner to operate at a profit. Many mines were forced to close down, and the gold output of not only California, but of the other western gold states, decreased greatly. Economic conditions are now slowly improving, and gold production is again on the upward trend. This is evidenced by the increase of nearly a million and a half dollars in value for 1921 over the 1920 yield. This, too, in spite of the continued shut-down of all but one of the large copper properties, which have always been important producers of by-product gold and silver.

Outlook for 1922.

According to the mid-year review of Yale[1], mint and smelter receipts for the first six months of 1922 have totaled $7,721,258 in gold, or $371,140 more than during the first six months of 1921:

> "The gold-mining industry is slowly recovering from the effects of the war, but a number of the mines still continue to work under restrictions and few large deep or placer mines are being started. The increase in the output of gold appears to be coming from an added number of small mines, both deep and placer, that are worked by their owners or lessees rather than from the properties of the larger companies, but the increase is mainly in the output of the dredges, more gold coming from the dredges now than from all the deep mines in the State. The ratio of increase in the output of gold from the deep mines is about 4 per cent and that of the increase from the combined placers, including dredges, is 15 per cent. The water supply for the hydraulic and other placer mines has generally been good, but it came a month or more later than usual, owing to cold weather and the packing of snow on the mountains, and this condition naturally reduces somewhat the receipts of gold from the placer mines early in the year."

Production in 1921.

The State Mining Bureau has never independently collected statistics of gold and silver production, as there is no necessity for duplicating the very thoroughly organized work of the U. S. Geological Survey covering those metals. The data here given relative to these two metals have been received through the courtesy and cooperation of Mr. Charles G. Yale, Statistician in Charge of the San Francisco branch office of the Division of Mineral Resources. Anyone wishing fuller details of the production of these metals may obtain the same by applying to the U. S. Geological Survey, Washington, D. C., or to room 303, U. S. Custom House, San Francisco, California, for a copy of the 'separate' on the subject.

---

[1] Yale, Chas. G., U. S. Geol. Surv., Press Bulletin July 20, 1922.

The gold production of California for 1921 was distributed, by counties, as follows:

County	Value	County	Value
Amador	$2,167,443	Placer	$132,468
Butte	456,760	Plumas	127,148
Calaveras	1,495,758	Sacramento	1,690,662
El Dorado	34,109	San Bernardino	217,568
Fresno	13,085	Shasta	267,681
Humboldt	2,054	Sierra	612,267
Imperial	537	Siskiyou	42,635
Inyo	80,373	Stanislaus	18,439
Kern	84,698	Trinity	437,993
Lassen	39,943	Tuolumne	96,026
Madera	1,053	Yuba	4,738,248
Mariposa	331,295	Del Norte, Los Angeles, Orange, San Diego*	3,991
Mendocino	1,509		
Merced	3,163		
Mono	37,754		
Nevada	2,570,162	Total value	$15,704,822

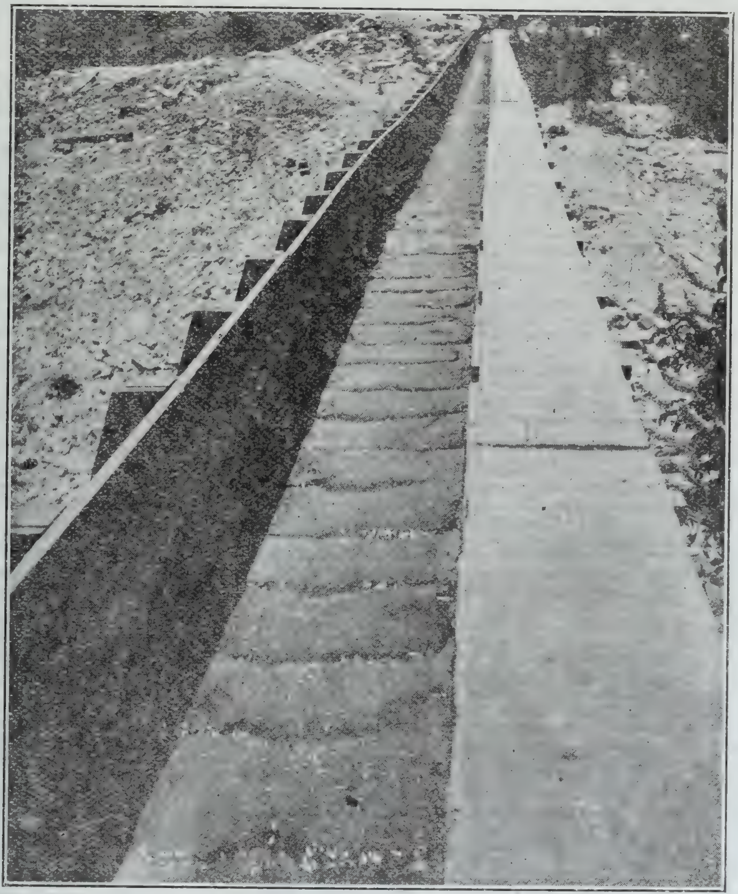
---

*Combined to conceal output of a single operator in each.

Shoveling gold in sluice-box during clean-up of Elephant Hydraulic Mine, Volcano, Amador County, Cal., June 24, 1922. The bright patch in front of the shovel, and streak diagonally across the flume at upper edge of gravel, is washed gold in small-size nugget form.

The following is quoted from the advance chapter on Gold in 1921, by courtesy of Mr. Charles G. Yale, of the U. S. Geological Survey:

"A somewhat gratifying condition is shown in certain of the metal-mining industries in California, as proven by the material increase in value of total output in 1921, while in others depression still exists. The increase is entirely due to the improvement in gold and silver mining in the State, the copper, lead, and zinc industries all showing greatly decreased output, as compared with 1920. The total value of these metals produced in California in 1921 was $20,952,423, which is an increase of $1,978,763 over 1920. Only one of the larger copper-mining companies continued operations throughout the year and most of the smaller mines remained idle. The large lead-producing companies curtailed operations or shut down entirely, and what shipments were made by any of the mines were comparatively small. Only one producer of zinc reported output and that was in an experimental or test way with the process of recovery adopted. Deep-mine gold output increased 4 per cent, but placer gold increased 15 per cent. The deep-mine silver increased 114 per cent, while the increase from placers was only nominal. Costs of mining all the metals still continued higher than the normal rate, which has naturally resulted in curtailment of operations among the larger mines and kept many, large and small, entirely idle. Under such conditions inauguration of new enterprises has been exceptionally small in number and older companies have not spent much money in new equipment or in prospecting new ground. Development has continued, however, where circumstances have warranted, but smaller crews have been employed than usual, as none of the companies have shown a desire to close down entirely, except where conditions have compelled them to do so. For the first time in many, many years the placer gold output has exceeded that from



Pine-block riffles in sluice-box of Elephant Hydraulic Mine, at Volcano, Amador County.

the deep mines, for in 1921 the placers led by over half a million dollars. This supremacy was gained by the activities of the gold dredges.

"In the five Mother Lode counties of the State, in one of which the deepest gold mines are in operation, the output of siliceous milling ore increased to some extent in 1921, but the average recovery per ton of ore was less by 97 cents.

"The average value of all metals from ores of the State in 1921 was $10.50, as compared with $10.20 a ton in 1920. From ordinary ore sent to gold and silver mills the recovery was $7.67 in gold and $0.09 in silver, compared with $8.34 a ton in gold and 0.16 in silver in 1920. The recovery from concentrates treated was $29.15 a ton in gold and $5.89 in silver, compared with $24.22 a ton in gold and $6.34 in silver. Crude ore of all kinds sent to smelters averaged $5.02 in gold and $75.61 in silver. Old tailings treated—38,299 tons—averaged $2.84 in gold and $0.56 in silver.

"The details of mining work in the Mother Lode counties of California are given in the section on production by counties. It is to be borne in mind that these figures are by county, not strictly confined to the actual mines in the Mother Lode itself, as generally recognized, but include those on the so-called East belt and others in the respective counties. By far the largest production, however, is from mines in the Mother Lode itself."

* * * * * * *

"The mine production of gold in California in 1921 was $15,704,822, or $1,393,779 more than in 1920. Of the deep-mine gold 99 per cent was derived from siliceous ore. Of the placer gold the dredges yielded $856,421 more than in 1920; the hydraulic mines $96,575 more; the drift mines $64,486 more; and the surface or sluicing mines $76,729 more. From 1898, when gold-dredging began in California, to the end of 1921, the gold output from that source has been $124,992,984. Since 1898 the Oroville or Feather River dredging field, in Butte County, has yielded $31,698,775, not including $2,556,216 derived in the last 12 years from the adjacent fields in the same county; from 1903 to 1921, inclusive, the Marysville, or Yuba River field, in Yuba County, produced $44,234,042; and since 1902 the Folsom, or American River field, in Sacramento County, has produced in gold $28,501,049. Dredges have also been, and are being, operated in several smaller fields in other northern counties of the State.

"The placer mines produced 52 per cent of the total gold yield in 1921 and the deep mines 48 per cent, as compared with 49 per cent and 51 per cent in 1920. This is the first time since the enforced restrictions on hydraulic mining that gravel mines have exceeded the output of the quartz mines in gold in California. The dredges produced 49 per cent of the total gold from all sources in 1921. Of the total placer gold, dredges produced 95 per cent, hydraulic mines 2 per cent, drift mines 2 per cent, and sluicing mines 1 per cent. The larger dredging fields are at Oroville, Butte County; Folsom, Sacramento County; and Hamilton, Yuba County. In these 3 fields 20 dredges were working in 1921, but there were also 1 in an 'outside' field of Butte County, 1 in Amador, 3 in Calaveras, 1 in Placer, 4 in Shasta, 2 in Stanislaus, and 3 in Trinity. Yuba County made by far the largest increase of gold output in 1921, as compared with 1920—$1,266,112—and reached the highest peak of total production ever obtained in any dredging field in the State. Sacramento also increased its dredge-gold yield by $112,902, but Butte County shows a reduction of $21,633 for the year.

"It should be mentioned here that certain difficulties are met with in the arrangement of the 'distribution' of gold in California; that is, placing its exact origin by county, and also that some counties are apt to be credited with a larger output of gold than they are really entitled to. The reason is that in certain mining centers, like Grass Valley and Nevada City, in Nevada County, Jackson, in Amador County, Redding, in Shasta County, Oroville, in Butte County, Yreka, in Siskiyou County, and so on, gold is brought for sale to banks, or buyers, or for express shipments from quite a circle within range of these towns. This is mostly from small mines, leased and individually worked, by foreigners who will not answer inquiries, and very much of it from 'high-graders.' The latter gentry prefer, when possible, to sell or ship their gold at or from points at some distance from where it was mined. The shipments are made by express or private hands. Hundreds of small lots are received by storekeepers in exchange for goods, and by banks and gold-dust buyers, who make no note of the name of the seller or the locality he comes from. But these in the aggregate make large sums in a year and must be credited, for example, to 'small mines at Grass Valley,' but much of the gold may have come from Placer, Yuba, Sierra, Plumas, Butte, or other neighboring counties. There is no way of telling the exact origin, however, as the question is not asked by the buyers. In the centers named, as well as in others, much gold accumulates in the way described and is then sent to be minted.

* * * * * * *

"The gold recovered from ore and tailings in California in 1921 was as follows: By amalgamation, 283,404.29 fine ounces; by cyanidation, 38,100.18 fine ounces, a large part of which was derived from the concentrates; from concentrates and ore sent to smelters, 43,726.68 fine ounces. These figures are only approximate, as many small operators keep no separate accounts, and even the larger companies do not always segregate the quantity of gold obtained by methods of treatment. This is especially the condition where larger mills amalgamate in the batteries and on the plates and pass the tailings and concentrates direct to the cyanide plants. All the placer gold was recovered by amalgamation."

Total Gold Production of California.

The following table was compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures since 1904 are those prepared by the U. S. Geological Survey:

Year	Value	Year	Value
1848	$245,301	1886	$14,716,506
1849	10,151,360	1887	13,588,614
1850	41,273,106	1888	12,750,000
1851	75,938,232	1889	11,212,913
1852	81,294,700	1890	12,309,793
1853	67,613,487	1891	12,728,869
1854	69,433,931	1892	12,571,900
1855	55,485,395	1893	12,422,811
1856	57,509,411	1894	13,923,281
1857	43,628,172	1895	15,334,317
1858	46,591,140	1896	17,181,562
1859	45,846,599	1897	15,871,401
1860	44,095,163	1898	15,906,478
1861	41,884,995	1899	15,336,031
1862	38,854,668	1900	15,863,355
1863	23,501,736	1901	16,989,044
1864	24,071,423	1902	16,910,320
1865	17,930,858	1903	16,471,264
1866	17,123,867	1904	19,109,600
1867	18,265,452	1905	19,197,043
1868	17,555,867	1906	18,732,452
1869	18,229,044	1907	16,727,928
1870	17,458,133	1908	18,761,559
1871	17,477,885	1909	20,237,870
1872	15,482,194	1910	19,715,440
1873	15,019,210	1911	19,738,908
1874	17,264,836	1912	19,713,478
1875	16,876,009	1913	20,406,958
1876	15,610,723	1914	20,653,496
1877	16,501,268	1915	22,442,296
1878	18,839,141	1916	21,410,741
1879	19,626,654	1917	20,087,504
1880	20,030,761	1918	16,529,162
1881	19,223,155	1919	16,695,955
1882	17,146,416	1920	14,311,043
1883	24,316,873	1921	15,704,822
1884	13,600,000		
1885	12,661,044	Totals	$1,735,922,923

GYPSUM.

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletins 38, 67.

Gypsum is widely distributed throughout the state, and is produced to a considerable extent, to supply the fertilizer manufacturers and also those of plaster and cement.

The action of gypsum as a fertilizer was formerly considered to be indirect[1]; that it was not a food for plants, but was supposed to act on the double silicate of magnesia and potash in the soil, freeing the magnesia and potash, so that they become available as plant food. Its use was believed to be beneficial only if these elements are present in the soil. More recently, investigations are stated to prove that gypsum serves as a source of both sulphur and calcium, which are plant foods.

Some authorities hold that land plaster tends to make nonporous clay soils more pervious to water and to make sandy soils less pervious. Ground gypsum has an affinity for water and will draw moisture from the atmosphere, so it keeps moisture in the soil and is of value to the farmer who is starting grain and grass crops, as it holds moisture where the roots of the small plants most need it. The use of ground gypsum or land plaster in a dry, hot season may draw enough moisture from the atmosphere to save a crop from damage by drought. Land plaster is employed to neutralize the black alkali that forms in many of the soils of arid regions, as in parts of California, Nevada and Utah.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

In the calcined form as plaster of Paris, gypsum plays a very important part in surgical work. It is also widely used in building operations, as a hard-wall plaster, as plaster board, etc. Approximately 2% of raw gypsum is added in the manufacture of Portland cement just before the final grinding.

During 1921, producers in Kern and San Bernardino counties took out a total of 37,412 tons, valued at $78,875, compared with 20,507 tons, valued at $92,535, in 1920.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1906	21,000	$69,000
1888	2,500	25,000	1907	8,900	57,700
1889	3,000	30,000	1908	34,600	155,400
1890	3,000	30,000	1909	30,700	138,176
1891	2,000	20,000	1910	45,294	129,152
1892	2,000	20,000	1911	31,457	101,475
1893	1,620	14,280	1912	37,529	117,388
1894	2,446	24,584	1913	47,100	135,050
1895	5,158	51,014	1914	29,734	78,375
1896	1,310	12,580	1915	20,200	48,953
1897	2,200	19,250	1916	33,384	59,533
1898	3,100	23,600	1917	30,825	56,840
1899	3,663	14,950	1918	19,695	37,176
1900	2,522	10,088	1919	19,813	50,579
1901	3,875	38,750	1920	20,507	92,535
1902	10,200	53,500	1921	37,412	78,875
1903	6,914	46,441			
1904	8,350	56,592	Totals	547,558	$1,978,336
1905	12,859	54,500			

---

[1] U. S. G. S. Press Bulletin No. 374, July, 1918, p. 4.

INFUSORIAL AND DIATOMACEOUS EARTHS.

Bibliography: State Mineralogist Reports II, XII, XIII, XIV, XV, XVII, XVIII. Bulletins 38, 67. Am. Inst. Min. Eng., Bull. 104, August, 1915, pp. 1539-1550.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes, and safes and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultra-marine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier maché, and for solidifying bromine. For making insulating brick the material is sawed from blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality. Infusorial earth is also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

The 1921 production showed a decrease both in tonnage and value from the 1920 figures of 60,764 tons, and $1,056,260. As over 95% of the output was from a single, large operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were four operators in 1921, in Monterey, San Luis Obispo, and Santa Barbara counties.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1907	2,531	$28,948
1890			1908	2,950	32,012
1891			1909	500	3,500
1892			1910	1,843	17,617
1893	50	2,000	1911	2,194	19,670
1894	51	2,040	1912	4,129	17,074
1895			1913	8,645	35,968
1896			1914	12,840	80,350
1897	5	200	1915	12,400	62,000
1898			1916	15,322	80,649
1899			1917	24,301	127,510
1900			1918	35,963	189,459
1901			1919	40,200	217,800
1902	422	2,532	1920	60,764	1,056,260
1903	2,703	16,015	1921	*	*
1904	6,950	112,282			
1905	3,000	15,000	Totals	240,232	$2,134,621
1906	2,430	14,400			

*Under 'unapportioned.'

LIME.

Bibliography: Reports XIV, XV, XVII. Bulletin 38.

Lime to the amount of 463,534 barrels, valued at $610,619, was produced by seven plants in five counties during 1921, as compared with 463,144 barrels, valued at $557,232 in 1920.

So far as we have been able to segregate the data, this figure includes only such lime as is used in building operations. That utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Distribution by counties is shown in the following table:

County	Barrels	Value
Kern	72,629	$141,491
Santa Cruz	122,907	242,869
San Bernardino, Shasta, Tuolumne*	267,998	226,259
Totals	463,534	$610,619

*Combined to conceal output of a single operator in each.

For table of production, by years, see under 'industrial' limestone, *post.*

LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII. Bulletin 38. Oregon Agr. College, Extension Bulletin 305.

Limestone was produced in eight counties during 1921, to the amount of 75,921 tons, valued at $305,912, being a decrease in tonnage but an increase in value over the 1920 output of 90,120 tons, worth $298,197.

The amount here given does not include the limestone used in the manufacture of cement, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special, chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel', whiting for paint, kalsomine, terrazzo, chicken grit, carbon dioxide gas, 'paving compound', and facing dust for concrete pipe. That indicated in the table below as coming from Santa Clara County is a calcareous marl sold for agricultural purposes.

In agriculture, the chief reason for the use of lime is now recognized to be that of correcting soil acidity. Lime is stated to be especially necessary for the proper development of the bacteria in the nodules on the roots of the legumes such as the clovers and alfalfa. It will also combine with some of the plant food materials already in the soil to make them more readily available, and will supply any lack of calcium as a plant food that may exist in the soil. To some extent, certain forms of lime will make heavy soils more friable, thus aiding aeration, cultivation and drainage. It may be applied, ground, in either the burned or unburned form, or as hydrated lime.

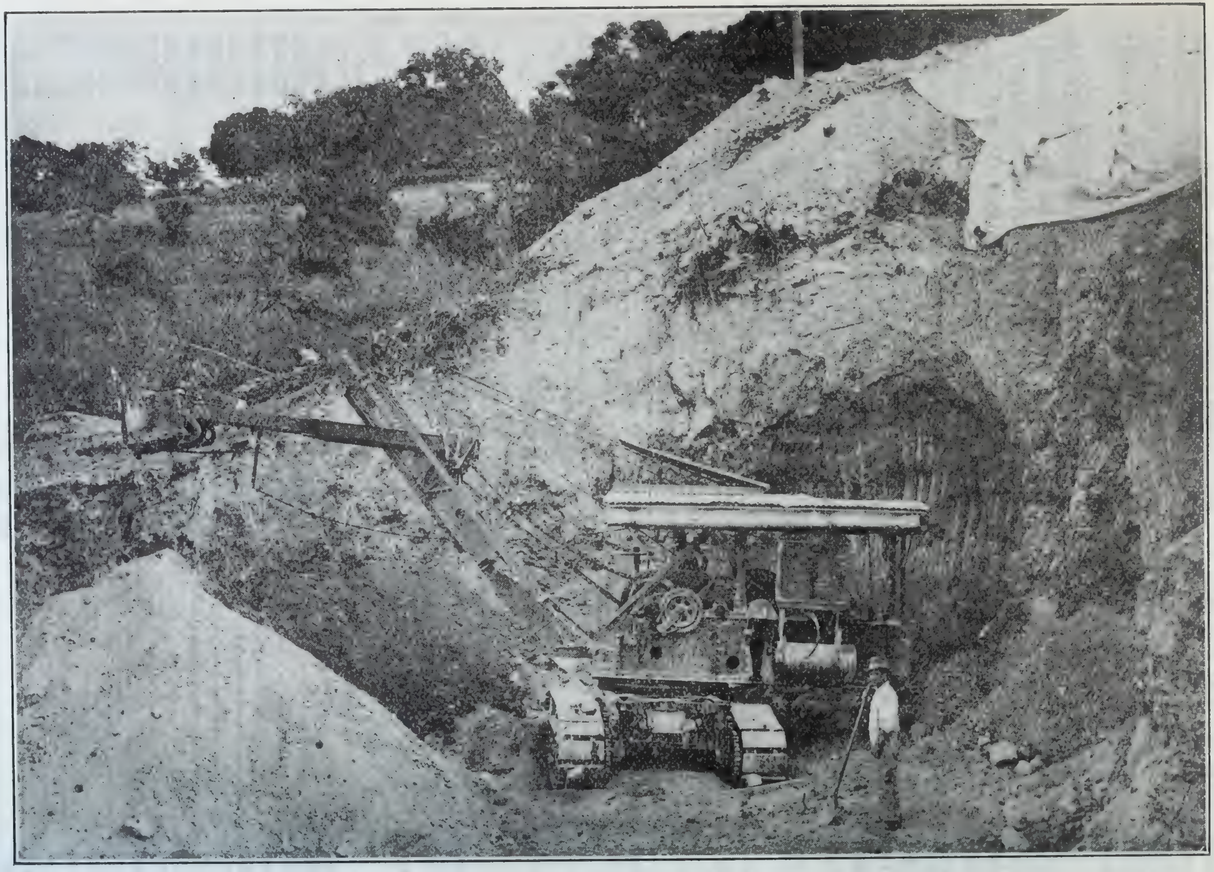
Distribution of the 1921 output was as follows:

County	Tons	Value
El Dorado	15,296	$66,143
San Bernardino	21,862	106,195
Tulare	10,030	40,090
Tuolumne	3,650	9,475
Kern, Los Angeles, Santa Clara[1], Santa Cruz[2]	25,083	84,009
Totals	75,921	$305,912

[1] Calcareous marl, used for fertilizer.
[2] Combined to conceal output of a single operator in each.

In the early reports of this Bureau values for lime and limestone were not segregated. The following tabulation shows the total combined value of such material since records for the state were first compiled, in 1887, to date:

Year	Value	Year	Value
1887	$368,750	1906	$925,887
1888	381,750	1907	1,162,417
1889	416,780	1908	676,507
1890	350,000	1909	997,745
1891	300,000	1910	1,058,891
1892	300,000	1911	843,778
1893	301,276	1912	1,034,688
1894	337,975	1913	803,002
1895	457,784	1914	896,376
1896	332,617	1915	442,592
1897	291,465	1916	608,208
1898	278,558	1917	667,776
1899	343,760	1918	917,573
1900	315,231	1919	800,188
1901	434,133	1920	855,429
1902	460,140	1921	916,531
1903	582,268		
1904	658,956	Total	$21,397,681
1905	878,647		



Bernal calcareous marl deposit, Edenvale, Santa Clara County. Photo by courtesy of Bernal Marl Fertilizer Co., San Jose, Cal.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII, XVIII, inc. Bulletin 67. Min. & Sci. Press, March 1, 1919.

Silver in California is produced largely as a by-product from its association with copper, lead, zinc, and gold ores. As explained under the heading of Gold, the State Mining Bureau does not collect the statistics of silver production independently of the U. S. Geological Survey.

The average price of silver during 1921 was $1.09 per ounce at New York as compared with 54.8¢ in 1914; 50.7¢ in 1915; 65.8¢ in 1916; 82.4¢ in 1917; $1 in 1918; $1.12 in 1919; $1.09 in 1920.

The following paragraph is quoted from the U. S. Geological Survey Advance Chapter on 1921, by courtesy of Mr. Chas. G. Yale, statistician in charge of the San Francisco branch office:

> "The production of silver in California in 1921 is shown in the table below. By far the largest output was made by San Bernardino County, followed in order of rank by Plumas and Inyo counties. The large silver output of the State, the greatest in years, was mainly from the mines and leased properties of the California Rand Silver, Inc., in San Bernardino County.
>
> "The silver recovered from the ore and tailings treated in 1921 was as follows: By amalgamation, 67,827 fine ounces; by cyanidation, 12,729 fine ounces; and by ores directly smelted or from concentrates from the flotation process, 3,510,037 fine ounces."

Silver output is sustained and encouraged through the operation of the Pittman Act maintaining the price of domestic silver at $1.00 per ounce minimum. The following statement from the mid-year review by Yale[1] shows the status of the industry for the first six months of the current year, 1922:

> "The silver received during the first half of 1922 by the mint and local smelters and refiners amounted to $1,440,842, valued at $1 an ounce, or $157,147 less than in the first half of 1921, when silver was valued at $1.09 an ounce. This decrease is due to the continued idleness of most of the large copper and lead producing mines, from which much of the silver mined in California is derived. The silver mines in San Bernardino County are increasing their output somewhat, but not sufficiently to counteract the loss in the output of copper and lead ores. The mines that now produce the most silver are the California Rand Silver Inc., the Grady lease on the same mine, in San Bernardino County, and the Engels copper mine, in Plumas County."

The distribution of the 1921 silver yield, by counties, was as follows:

County	Value
Amador	$35,460
Butte	1,759
Calaveras	10,232
El Dorado	301
Fresno	75
Humboldt	37
Imperial	920
Inyo	86,020
Kern	1,897
Lassen	1,234
Madera	27
Mariposa	5,251
Mendocino	13
Merced	87
Mono	15,160
Nevada	33,906
Placer	$1,068
Plumas	171,090
Sacramento	5,254
San Bernardino	3,210,706
Shasta	5,581
Sierra	5,236
Siskiyou	294
Stanislaus	136
Trinity	1,390
Tuolumne	2,505
Yuba	26,135
Del Norte, Los Angeles, Orange, San Diego*	7,449
Total	$3,629,223

---

[1] Yale, Chas. G., U. S. Geological Surv., Press Bulletin, July 20, 1922.

*Combined to conceal output of a single operator in each.

Silver Production of California by Years.

The value of the silver produced in California each year since 1880 has been as follows, the data previous to 1887 being taken from the reports of the Director of the Mint. There are no data available for the years previous to 1880:

Year	Value	Year	Value
1880	$1,140,556	1902	$616,412
1881	750,000	1903	517,444
1882	845,000	1904	873,525
1883	1,460,000	1905	678,494
1884	[1]4,185,101	1906	817,830
1885	2,568,036	1907	751,646
1886	1,610,626	1908	873,057
1887	1,632,004	1909	1,091,092
1888	1,700,000	1910	993,646
1889	1,065,281	1911	673,336
1890	1,060,613	1912	799,584
1891	953,157	1913	832,553
1892	463,602	1914	813,938
1893	537,158	1915	851,129
1894	297,332	1916	1,687,345
1895	599,790	1917	1,462,955
1896	422,464	1918	1,427,861
1897	452,789	1919	1,240,051
1898	414,055	1920	1,859,896
1899	504,012	1921	3,629,223
1900	[2]724,500		
1901	[2]571,849	Totals	$46,448,942

---

[1] Lawver, A. M., in Production of Precious Metals in United States: Report of Director of Mint, 1884, p. 175; 1885.

[2] Recalculated to 'commercial' from 'coining value,' as originally published.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

19664. *Cinnabar* (HgS), mercuric sulphide. High grade, crystalline. From Seitz Mine, near Mina, Nevada, by Henry J. Seitz, Mina, Nevada.

19667. Free *Gold* (Au) in quartz, in part, with sulphides. Four pieces of high grade ore, showing crystallized and leaf gold. From North Star Mine, Nevada County, Cal., by North Star Mines Co.

19668. *Mineral Water*, from well, after cooling. From Calistoga Geyser Well, Napa County., Cal., by G. Musante, Calistoga.

19669. *Chalcedony* & *Quartz Geodes* and Amygdules. From Berkeley Hills, Alameda County, Cal., by T. H. d'Estrella, Berkeley.

During the month a total of 603 visitors signed their names on the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

There were 304 samples received and determined during the thirty-day period covered by this report. Among this number there were but few of special scientific interest. The public are showing a live and increasing desire to find good deposits of the non-metals and salines, and the outlook in that field is promising.

The samples, as submitted, covered a wide range. About fifty tests were made for the precious metals; in one case platinum was detected, and gold in several instances.

The public is earnestly invited to send such samples of minerals to this laboratory as may seem to have an economic or scientific value. The work is carried on without cost to residents of this state, and it is by means of these finds that the mineral wealth of the state is revealed. The possibilities of discovery of minerals of commercial value within the state are very great, and that the number of prospectors is on the increase is evidenced by the fact that the number of samples turned in to the bureau is steadily growing.

Occasionally a sample is received that is interesting not only in a mineralogical way, but proves the occurrence in the state of a rare metal or mineral in possible commercial quantities. One such sample recently received for the Museum was of allanite—a complex silicate containing the cerium metals. Judging from the sample submitted, the deposit may have a commercial value as a source of these metals.

A list of samples of possible commercial value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–191	Octahedrite (titantium dioxide).
05–192	Schist; contains lead, zinc, gold, silver, and copper.
05–193	Asbestos (chrysotile); short fibre.
05–194	Lead-silver-copper-gold ore.
05–195	Gold ore; very high-grade.
05–196	Kaolin-like mineral; good grade clay.
05–197	Fibrous anthopyllite.
05–198	Kaolinized rock.
05–199	Copper ore; high-grade—some gold and silver present.
05–200	Deweylite (variety of serpentine); also amphibole asbestos.
05–201	Gold ore; over $20 per ton.
05–202	Lead-silver ore.
05–203	Mica.
05–204	Arsenopyrite.
05–206	Copper ore; some gold present.
05–207	Cobalt.
05–208	Ferruginous shale.

05–209	Gold ore.
05–210	Gold ore; over $20 per ton.
05–211	Gold ore; over $10 per ton.
05–212	Marl.
05–213	Gypsum.
05–214	Copper ore, with some silver.
05–215	Lead, copper, silver ore.
05–216	Arsenopyrite.
05–217	Kaolinized rock; high alumina content.
05–218	Copper-cobalt ore.
05–219	Pure white quartz.
05–220	Massive garnet.
05–221	Barite.
05–222	Copper ore.
05–223	Diatomaceous earth.
05–224	Feldspar.
05–225	Dolomite.
05–226	Gold ore; value over $20 per ton.
05–227	Marl.
05–228	Marl.
05–229	Kaolinized rock; alumina content high.
05–230	Manganese oxide.
05–231	Copper ore.

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

- U. S. Geol. Survey Bulletins:
  - No. 736-A—The Structure of the Madill-Denison Area, Oklahoma and Texas. By O. B. Hopkins, Sidney Powers and H. M. Robinson.
  - No. 730-B—Erosion and Sedimentation in the Papago Country, Arizona. By Kirk Bryan.
- U. S. Geol. Survey Mineral Resources:
  - Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1920. By Charles W. Henderson.
  - Silica in 1921. By L. M. Beach.
  - Magnesium in 1921. By G. F. Loughlin.
  - Zinc in 1921. By C. E. Siebenthal and A. Stoll.
  - Abrasive Materials in 1921. By L. M. Beach and A. T. Coons.
  - Peat in 1921. By R. W. Cottrell.
- U. S. Bureau of Mines Bulletins:
  - No. 200—Evaporation Loss of Petroleum in the Mid-Continent Field. By J. H. Wiggins.
  - No. 207—The Analytical Distillation of Petroleum and Its Products. By E. W. Dean, H. H. Hill, N. A. C. Smith and W. A. Jacobs.
- U. S. Bureau of Mines Technical Papers:
  - No. 268—Preparation and Uses of Tar and Its Simple Crude Derivatives. By W. W. Odell.
  - No. 298—Methods for Testing Petroleum Products. (A Handbook for Inspecting Laboratories.)

U. S. National Museum. Smithsonian Institution. Contributions from the United States National Herbarium. Vol. 22, Part 6—Grasses of British Guiana. By A. S. Hitchcock.

Annual Report of the Smithsonian Institution, 1920.

Illinois State Geological Survey, Extract from Bulletin No. 38—Geology and Mineral Resources of the Avon and Canton Quadrangle. By T. E. Savage.

Illinois State Geological Survey, Extract from Bulletin No. 38—Further Investigations of Illinois Fire Clays. By C. W. Parmlee and C. R. Schroyer.

Illinois State Geological Survey, Extract from Bulletin No. 43—Geology and Mineral Resources of the La Harpe and Good Hope Quadrangles. By T. E. Savage and M. L. Nebel.

Kentucky Geological Survey—Oil Field Stratigraphy of Kentucky. By Willard Rouse Jillson.

Province of Quebec, Canada Department of Colonization and Fisheries, Bureau of Mines. Report of Mining Operations in the Province of Quebec.

Canada Department of Mines, Mines Branch—Barium and Strontium in Canada. By Hugh S. Spence.

Department of Mines, Geological Survey of Victoria—Bulletin No. 45—Brown Coals of Victoria, Melbourne, Australia.

Secretaria De Industria, Commercio Y Trabajo, Boletin Minero, Tomo XIII—Numero 4. Mexico.

Secretaria De Industria, Commercio Y Trabajo, Boletin Del Petroleo, April De 1922. Mexico.

Geology of the An-Shan Iron Mine District, South Manchuria. By Hanzo Murakami.

Republica Argenta. Ministero De Agricultura De La Nacion, Boletin No. 29—Estudios Geologicos En El Valie Superior De Rio Negro. Por El Doctor Anselmo Windhausen.

Boletin No. 30—Observaciones Geologicas En El Gran Bajo De San Julian. Por Dr. Ricardo Wichmann.

Boletin No. 28—Apuntes Geologicos Sobre Los Hallazgos De Carbon Al Sur Del Lago Nahuel Huapi. Por El Dr. Juan Rassmuss.

Societies and Educational Institutions.

Transactions of the American Institute of Mining and Metallurgical Engineers, Vol. LXVI.

Proceedings of the Engineers' Society of Western Pennsylvania, Vol. 37—No. 10.

Quarterly of the Colorado School of Mines, April, 1922.

University of California, Department of Geological Sciences, Vol. 13—No. 6—Geology of the Cuyamaca Region of California.

Vol. 13—No. 10—New Species from the Cretaceous of the Santa Ana Mountains, California.

State of Washington, Department of Conservation and Development, Bulletin No. 26—Underground Water Supply of the Region about White Bluff and Hanford. By Olaf P. Jenkins.

Research Publications of the University of Minnesota. Studies in Engineering. No. 4—An Investigation of Secondary Stresses in The Kenova Bridge.

Economic Geology, June and July, 1922.

The American Mineralogist, June, 1922.

Journal of Geology, May and June, 1922.

Mining and Metallurgy, June and July, 1922.

Records of the Australian Museum—Vol. XIII—No. 5. Sydney, Australia.

Memorias De La Real Academia De Ciencias Y Artes De Barcelona:

Vol. XVII—Num. 9—Las Leyes Graficas En Los Espacios No—Euclideos. Por J. M. Bartrina Y Capelia.

Vol. XVII—Num. 10—Las Fenilcumarinas. Por R. F. Dr. Eduardo Vitoria, S. J.

Vol. XVII—Num. 11—Excursiones Geologicas Por La Provincia De Burgos. Por Dr. D. M. San Miguel De La Camara.

Vol. XVII—Num. 12—Monografia De Los Melusinidos De Las Islas Canarias. Por Dr. Elias Santos Abreu.

Maps.

U. S. Geol. Survey Topographic Sheets:
- Kentucky Well Quadrangle, Madera County, Cal.
- California Oxalis Quadrangle.
- Gregg Quadrangle, Madera County, Cal.
- Charleston School Quadrangle, Merced County.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport-Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Georgetown Gazette, Georgetown, Cal.
Gateway Gazette, Beaumont, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Humboldt Standard, Eureka, Cal.
Healdsburg Enterprise, Healdsburg, Cal.

Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mountain Messenger, Downieville, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Nevada Mining Press, Reno, Nevada.
Oroville Daily Register, Oroville, Cal.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Plumas National Bulletin, Quincy, Cal.
Plumas Independent, Quincy, Cal.
Placer Herald, Auburn, Cal.
Petroleum Reporter, Etna Mills, Cal
San Diego News, San Diego, Cal.
Santa Barbara Daily News,, Santa Barbara, Cal.
Stockton Record, Stockton, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Sacramento Union, Sacramento, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–94 Chalcedony—has an immense deposit.
02–95 Chrysotile asbestos (short fibre—rips to $\frac{3}{4}$ inch).
02–96 Dolomite deposit.
02–97 Deposit of diatomaceous earth.
02–98 Barytes.
02–99 Coal and oil.
02–100 Gold quartz property; operating, 2 leads, 2-stamp mill; or capital for further development.

Mineral Products or Deposits Wanted.

03–84 Green fluorspar.
03–85 Chrome ore.
03–86 A small copper property.
03–87 Gold mine—somewhat developed.
03–88 Montmorillonite or bentonite.
03–89 Green rock for roof work. (There is a local market for 300 T. per month.)
03–90 Clean sand (above 70% silica) for making sand-lime brick.
03–91 Diatomaceous earth.
03–92 Zirconium.
03–93 Infusorial or diatomaceous earth.
03–94 Montmorillonite; diatomaceous earth; volcanic ash.
03–95 Soapstone, suitable for cutting into slabs.
03–96 Low-grade iron ore (40% to 50% iron).

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and address of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–21 Geologist. One year's experience with large Eastern oil company. Single. Age 29. References.

01–22 Superintendent Gravel Mine. Six years in charge of placer operations in California and over twenty years experience in such work. Married. Age 43. Salary wanted, $200 per month. References.

01–23 Mine Superintendent or Master Mechanic. Five years as miner, shift boss and foreman in Nevada; three years master mechanic in South America; six years general consulting practice. Age 35. Married. Salary wanted, $300 per month. References.

01–24 Mine Superintendent. Six years as engineer, superintendent and general manager in Arizona copper mines. General field experience. Age 39. Married. Salary wanted, $300 per month. References.

01–25 Mine or Mill Superintendent. Many years experience in Shasta and Trinity counties. Age 55. Married. Salary, open.

01–26 Geologist. Five years university training. Two months geologist for cement company. Age 31. Single. Salary wanted, $125 per month.

01–27 Topographic Draftsman. Eleven years experience as surveyor and draftsman. Age 32. Single. Salary wanted, $150 per month. References.

01–28 Engineer, Superintendent or Manager. Twelve years in managerial capacity and consulting work in California, Nevada and Spanish America. Age 37. Married. (Wife will not accompany.) Salary wanted, $200 and expenses, at least. References.

01–29 Any position wanted by university graduate. Age 25. Single. Salary not important. References.

AUGUST, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. TUCKER, Mining Engineer.

Modoc County.

Mathew J. Holt has acquired a controlling interest in the *Big Four Mine,* situated in the High Grade Mining District, eight miles east of New Pine Creek, Oregon.

The *Sunshine Mine,* which is situated on High Grade Hill, about 9 miles east of New Pine Creek, Oregon, has been leased by Thomas J. Highland and A. Thomson, of Alturas.

Shasta County.

The Bully Hill Smelter of the *Shasta Zinc and Copper Company,* after two months experimental work, is practically operating at full capacity, treating 150 tons of crude ore per day, with a production of 25 to 30 tons of zinc oxide, and 10 to 15 tons of copper matte. Two hundred men are employed.

The *Shasta Iron Company* have recently increased shipments of iron ore from the company's mine at Heroult. The iron ore is shipped to Oakland, San Francisco and Los Angeles. Twelve cars per month are being forwarded.

The company is also shipping lime rock to the Shasta Zinc and Copper Company at Bully Hill. Twelve men are employed. F. J. French, superintendent.

The *Quartz Hill Mine*, situated four miles northwest of Redding, in section 10, T. 32 N., R. 5 W., was recently sold for taxes. Regis Halter of Redding purchased the property.

The *Gold Leaf Mine*, situated four miles west of Redding, in section 5, T. 31 N., R. 5 W., in Shasta Mining District, is being reopened by Ira Judson Coe of San Francisco.

The shaft has been retimbered down to the 120-foot level. Four men are employed. G. E. Bateman, superintendent.

The *Double Header Mine*, which is situated near Tower House, is being developed by Charles Garrett and associates of Redding. A new two-stamp mill has ben installed on the property, and the ditch line is being repaired, preparatory to starting milling operations. Charles Garrett is in charge of operations.

The *Chicago and Silver Falls Group of Mines*, situated in the South Fork Mining District, near Igo, has recently been bonded by Dr. F. M. Archer, of Redding, to Santa Barbara interests.

Twelve men are employed on development. Walter Parsons, superintendent.

The *Ruby Pearl Mine*, situated twelve miles west of Castella, in the Shasta Forest Reserve, in section 4, T. 38 N., R. 5 W., is being operated by Wm. Basham, Larsen, and Anderson of Castella, owners. The vein strikes northwest and southeast and dips 40 degrees east. It has a width of 12 inches to 2 feet, and occurs in diorite-porphyry.

Development consists of lower tunnel in 530 feet on the vein, and an upper tunnel 177 feet in length.

The lower and upper tunnels are connected by a raise on the vein.

There was a Straub mill and Deister concentrator on the property. Two men are employed on development work.

S. Grensfield and M. Merrilees of Bully Hill recently located the *Eureka Mine* in the Pittsburg Mining District.

H. B. Conner and Fred Craven of Redding have located eight claims in the Shasta Mining District, five miles northwest of Redding. The claims located are known as: Gold Jack, Gold Wedge, Bald Eagle No. 1, and No. 2; Sunset No. 1, and No. 2; and Golden Queen No. 1, and No. 2.

Albert Grutska has located the *Mountain View Quartz Mine*, in the Old Diggins District, in section 10, T. 32 N., R. 5 W., eight miles north of Redding.

Siskiyou County.

There is renewed activity in placer mining on St. Clair Creek, two miles below Cecilville. Frederich Otto and Charles Mitchell are working the *Pelucca Placer Mine.*

The *Keynote Mine*, situated in the Fool's Paradise District is being operated by W. E. Anderson. The mill is working on ore assaying $40 per ton.

Harry and Joseph Davidson recently struck a rich pocket on Vesa Creek, which empties into the Klamath River, 12 miles from Yreka. The *Davidson Bros.* have taken out seventy ounces of gold quartz, one specimen containing seventeen ounces of practically pure gold.

The specimens so far taken out, represent about $1,700 worth of gold. The Board of Supervisors are contemplating buying them for the Siskiyou County Gold Exhibit.

Tehama County.

The *Tuscan Oil Company* has resumed drilling operations on its property, six miles north of Red Bluff. The well is down 1800 feet, and is drilling through sand and blue shale. Two shifts are employed. L. F. Richardson, superintendent.

Trinity County.

The *Foster Gold Mining Company,* owners of the *Bonanza King Mine,* recently suspended operations.

The *Bolliver Mine,* situated one and a half miles from Five Pines, is being developed by J. W. Gusack of Five Pines.

Five Pines Mine, in sections 20 and 29, T. 35 N., R. 8 W., in the Minersville Mining District, two miles northwest of Minersville, is being operated by lessees. Owner: Five Pines Mining Company of Minersville; N. J. Van Ness, president.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

Alpine County.

With an area of 776 square miles and less than 100 registered voters, this county is the least developed in the state. Placed as it is on the summits and east slope of the Sierra Nevadas it is geologically and geographically more closely allied to Nevada than to California, and except for a few acres in Carson Valley is everywhere made up of rugged mountains and deep canyons ranging from 5150 feet on the floor of the valley at the state line to peaks over 11,000 feet high. Grazing in summer is the principal industry at present. Mining began in 1861 with the finding of silver ores, which induced the belief that the county contained a continuation of the Comstock belt. Miners flocked in from Virginia City and other Nevada camps and a boom started that resulted in a number of ill-advised mining ventures. The failure of these gave the county a poor reputation among mining people. This handicap, apparently undeserved, has not been overcome, due to the remoteness of the district and the lack of a resident population interested in the development of the county's mineral resources.

TRANSPORTATION.

The county is reached from the western side by four good dirt roads, entering from Murphys, Jackson, Placerville and Truckee, the first named or Big Trees road, going in over Ebbett's Pass, 8900 feet in elevation and the last two via Luther's pass, elevation 7800 feet and a few miles south of Lake Tahoe. The nearest railroad point is Minden, Nevada, from which a good dirt road runs 18 miles to Woodfords, which is the junction with the roads from the west. Markleeville, the county seat, is 24 miles from Minden, and is reached either from Woodfords or by the Big Trees road, which follows the East Fork of Carson River. The roads are very well kept up and the principal mines are accessible by automobile

WATER, POWER AND TIMBER.

The two forks of Carson River offer numerous ideal power sites. The East Fork particularly passes near the principal mining districts and has been utilized by two mining companies who have built dams and generated electric power for mining and milling. In the undeveloped sections numerous tributaries could be utilized. Timber is plentiful in the higher mountains.

GEOLOGY AND MINERALOGY.

The granite forming the mountain range is covered over a large area and to undetermined depth by flows of andesite. Only one mine visited showed rock of strictly sedimentary origin. This is near the state line on the border of Carson Valley, where a body of white granular quartzite is claimed to carry gold. The main andesite area covers the east central part of the county from the higher summits to beyond the state line. Lindgren points out that near Silver Mountain the andesite shows a section from 3000 to 4000 feet thick. The principal mining development and production has been in an area about 3 miles square in the andesite, bounded on the west by the East Fork of Carson River and extending only a little south of Monitor Creek. Besides this there has been considerable work and some production at Silver Mountain. Outside these areas, only a little prospecting has been done. Grover's Hot Springs, 4 miles west of Markleeville, and other hot springs further north in Nevada, mark the course of a main north and south fault line. Dislocations in the vicinity of this line have probably given outlet to the heated water from deep seated sources. This water, rising through the andesite as hot springs, has kaolinized the andesite and deposited within it the ore bodies associated with quartz and chalcedony and in some cases with manganese compounds. Great outcrops of hard rock, formed by the silicification of the andesite along these fracture zones have been left standing by subsequent erosion of the softer andesite and are indicators of the general location of the ore bodies which occur below them. In some cases these immense croppings themselves carry gold and silver in narrow veins of sufficient richness to make ore of workable width. The main sulphide ore bodies are, however, irregular and without definite walls, and show branching stringers of high grade. Numerous geologists have considered it probable that zones of secondary enrichment carrying larger and better ore bodies than any yet mined, may be found some distance deeper than yet reached. Just how deep this zone will lie is a matter of conjecture, but estimates have ranged from 150 to 500 feet below the lowest present explorations. If present, such zones may be quite deep because of the permeable nature of the rock and the extent of fracturing. Copper carbonates are notably absent and chalcocite has been found in small amount so far. The unaltered andesite is grey-green and often brecciated. The first serious setback to mining here was experienced when it was found that the ores were not amenable in most cases to ordinary free milling processes. Most of the early failures were due to this. In the early years of mining only ore of the highest grade could be shipped on account of the expense of transportation, as it had to be hauled across the mountains to Sacramento.

The principal ore mined from the Morning Star Mine was enargite, which occurred in 'solid masses.' It carried silver and gold in addition to copper, also some antimony. The higher grade which was shipped carried up to 34% copper and had a value up to $400 a ton, including much silver and some gold. In the old stopes at present, and on the dump is a great deal of massive pyrite, some of it showing intimately mixed enargite. This pyrite carries gold and silver probably in payable quantity if the enargite did not interfere with cyaniding, but not rich enough to ship. The gangue is jasper, quartz and kaolinized andesite.

In the Colorado No. 2, which was the principal silver producer, the ore was a complex mixture of sulphides of lead, zinc, silver and antimony, with the richer ore carrying $100 a ton or more in gold and silver. Galena, pyrite and complex sulphides of silver and antimony are prominent. Eakle mentions numerous silver minerals from this mine. Rhodochrosite and black oxides of manganese accompany the ore and kaolin and silica are also gangue minerals. Some of the ore was deposited evidently in open fissures of irregular shape with the quartz and ore minerals freely crystallized. Veinlets and 'feeders' of rich ore with rhodochrosite extend through the altered andesite and have at time been followed until they made into good sized ore bodies.

The vein in the Exchequer Mine at Silver Mountain was described by A. Eilers as being of broken up quartz and clay, but of solid quartz in the ore shoots, and as being a true fissure vein 3 to 7 feet wide with well defined gouges. The ore minerals were stated to be pyragyrite (sulphantimonite of silver), proustite (sulpharsenite of silver), argentiferous stibnite and pyrite. Ore taken from the 100-foot level for milling in 1874 assayed from $51 to $66 silver per ton.

In some of the gold mines, notably in the Alpine and Boulder Hill, rich free milling gold ore occurred, but aside from these the ores have been base and have not been amenable to ordinary raw or free milling processes.

Outside of the two districts mentioned above there has been little done and not a single prospect is known to have been developed to a conclusive point, although some work has been done lately on a few to be mentioned.

ORE TREATMENT.

Most of the early day plants built in the county were failures. Even mills designed to handle free milling gold ores had a very low efficiency. It was first thought the bodies of silver ore were on a continuation of the Comstock Lode of Nevada. Raw milling and amalgamation would not work upon the silver ores, and concentrating tables were unknown at the time. The first stamp mill was built in 1863 and is said to have saved about 50% of the value indicated by assays. The charge was $30 a ton for milling. Next came kiln drying and crushing, with roasting and amalgamation by the Freiburg barrel process. Contracts were made in 1867 for ore to be treated by this process, but it proved unsuccessful when tried upon ore from the Morning Star Mine. The Silver Creek mill treated for the year ending July 1, 1869, 76 tons of ore yielding $110 a ton from the Tarshish, later the Colorado No. 2 Mine. In that year there were four quartz mills doing custom work in the county. The first one built was the Pioneer, with ten 400 lb. stamps and all were small affairs. The mining companies were not able to build their own mills and with custom mills unfitted for handling refractory ores, little progress could be made. Copper ores had to be hauled to Sacramento by wagon, for shipment to Swansea, so only rich ore could be handled. Silver-gold ores that carried less than $10 a ton could not be handled profitably, judging by old reports, because of expensive reverberatory roasting of crude ore, no concentrators being in use. In 1873 the manager of the principal company tried crushing the ore wet and amalgamating with salt and bluestone without roasting. The first run by this process gave a return of about $10 a ton; custom milling cost $15 a ton. In 1874 the same company completed a mill for wet raw treatment. It contained eight 600 lb. stamps, 4 Hepburn pans, 2 Hendy concentrators, and settling tanks for slimes and tailings. This mill had a capacity of 16 tons a day. After treating 100 tons of ore in it, the manager decided that roasting was necessary. The same year, the Monitor mill was described as containing 10 stamps, crushing dry, four amalgamating pans, a Knox pan, settlers and a McGlew furnace, designed for chloridizing roasting to be followed by amalgamation. Ore sent from the Exchequer Mine to this mill returned only 17% of the assay value. From these sidelights it is easy to see that the natural difficulties of pioneering were augmented by the inexperience of the metallurgists with this type of ores, which were different from anything they had handled before. As far as can be learned, the later operations at Silver Mountain were never successful.

Likewise, work at the silver-gold mines near Monitor was not profitable, and the principal mine, called Colorado No. 2, lay idle for several years because ore was not rich enough to pay for the expensive haul to the railroad, and no suitable means of working it locally had been found. Peter Curtz, who had been acquainted with the mine for many years, reopened it in 1878 and 1879, bringing with him the first Frue vanners seen on this coast and also an experienced metallurgist named Ottokar Hoffmann. The mill contained ten stamps, later 15, and 4 Frue vanners. An ore averaging $12 a ton was concentrated and treated by chlorination. Records of the assay value of the concentrate and the amount of bullion made during the summer of 1879 showed excellent recovery, ranging from 90% to 95% of the gold and silver in the concentrate.

Tests in the last few years by oil flotation are reported to have shown this process also well suited for the ores at Monitor.

SOME OF THE MINES.

Advance Mine has been previously described by the writer in this Bureau's report for 1920. Since that time, only assessment work has been done.

In the past few years, a number of experienced engineers have examined and sampled the mine and have tested the ore. Besides the narrow, rich stringers of mixed sulphides which have been followed as possible indicators of larger chambers, there is a large mineralized zone of low grade ore, with the silver sulphides scattered through the kaolin in grains and in minute opal seams. Ore sampling of all the drifts and crosscuts and raises, without, it is said, due regard to the boundaries of this low grade zone, are reported to have given an average of 3 ounces silver and $2 gold per ton. The ore would be extremely cheap to mine and mill on account of its soft nature, which permits picking, although it stands well.

All the accessible workings are upon or above the level of Advance tunnel, which opens upon the north bank of Monitor Creek just west of the old town of Monitor. A shaft was sunk in early days just outside the portal of this tunnel, to a depth of 300 feet or more. Good ore is reported to have been found in this shaft and some of it was milled but according to Peter Curtz, who was in charge of the mill, work was stopped here because the ore could not be successfully treated locally.

Alpine Mine was found by tracing float ore. It lies northwest of Colorado Hill, upon which the Monitor mines are found. There are here outcrops of jasper rock similar to those at Monitor, due to alteration of the andesite which in its unchanged state on this mine is a recemented andesite breccia or agglomerate, greenish-grey in color. As far as can be judged by an examination of outcrops and of such shallow openings as are accessible, and from information furnished, the gold occurs in narrow seams and stringers of quartz and iron oxides in the jasper and andesite, and at times disseminated through the flinty bluish rock in the finely crystallized sulphide of iron. These veins are said to be rich enough in gold to make ore of workable width.

What Peter Curtz regards as the main ledge of the series, strikes N. 33° W. and is traceable 3000 feet to the top of Colorado Hill. It is a jasper outcrop six feet wide where crosscut and is said to assay $1 to $6 a ton. This is 1000 feet east of the Alpine Mine workings.

The 'six ft. vein' on the Alpine claims shows on the surface as an outcrop of the andesite, carrying a series of veinlets ½ inch to 3 inches wide which strike north and dip vertically. What is termed the 16 ft. ledge also crosses the property. This is a formation of rich narrow stringers. On the Lewis claim of this group a series of adits driven years ago from the west slope in an easterly direction, are said to have crosscut these two 'veins.' The lowest of these was 1000 feet long and is said to have cut both zones which are only 80 feet apart and converging with depth. The No. 1 or six ft. ledge is reported one foot wide here and was stoped for a length of 100 feet and an unknown height. The No. 2 or 16 ft. ledge maintains its width and Curtz claims it assays $6 a ton in the crosscut but was not stoped as ore of that value could not be milled at a profit then. Seams in this vein are said to assay $80 a ton.

On Markleeville claim, and about 800 feet south of Lewis claim, several adits were also run, and a stope 80 ft. long by 80 ft. high was mined. The lowest tunnel is about 600 feet long and the vein there is about 6 feet wide. Ore in sight is reported worth $2.50 to $4.50 a ton. In addition to free gold, some silver ore occurs here. Total production of the group is uncertain; it is reported to have been $378,000, but there is no record at hand.

A tramway built to serve this group of claims has its upper terminal just below and between the two groups of adits. It is ¾ of a mile long and delivered ore by gravity to the company's mill on Carson River, 1000 feet lower. In spite of cheap mining, and milling by water power, it is stated that ore worth less than $7 a ton could not be profitably worked. The mill is still on the river and houses a hydro-electric power plant.

Boulder Hill Mine was the scene of the first gold discovery in the county about 1861. It is on the hill of the same name between the Alpine Mine and the river. The original discovery was of large boulders which when milled yielded at a fabulous rate in free gold, $20,000 being obtained from a few tons of ore. There has been no recent activity.

Colorado No. 2, formerly alluded to as the principal silver producer of the county, has been idle for many years. Since operation by Curtz in 1879–1880, the mine has passed through the hands of stock companies and a large plant for both mine and mill were put in, including dam and electric power plant on Carson River, electric locomotives for mine use, power line to the mine, steam and electric equipment for mill and hoist, etc. Most of this except 10 stamps and some concentrators, has been removed lately.

The ore is the same as in the Advance, and has been previously described herein; the claims adjoin and the Advance connects by a raise with the lower tunnel on Colorado No. 2. The mine was sampled in connection with the Advance when the two were under common ownership, and contains considerable ore of milling grade, according to the statement of a former operator, who says he left such ore in the mine. Ore averaging $12 a ton from this mine was successfully treated by stamping and concentration on Frue vanners by Peter Curtz in 1879, giving concentrate worth from $420 to $900 a ton, of which 38% to 43% was gold and the balance silver. Original records show that 91% to 95% of assay value of concentrate was recovered at the mine in bullion by chlorination. The early production from this mine, reported at half a million dollars, was made by working the ore in rockers and shipping concentrate.

The present company was a heavy loser by speculation in other business several years ago and has done no recent work. Only the patented claims remain in their possession now.

Exchequer Mine is in Silver Mountain District, at the head of Scandinavian Canyon. Up to 1875, the operating company spent $125,000 on the mine, mill and surface plant. An adit over 800 feet long was driven, with an inclined winze in an ore body 60 feet long at the tunnel level and increasing in size downward. Apparently the same ore body was struck in workings from a vertical shaft, and 60 feet below the winze. Another ore body 50 feet long and 20 inches wide was found in a crosscut from 100-ft. level of the vertical shaft. Raymond pointed out that these two small ore bodies appeared to be the tips of a larger body that might be found below. The ore was of good grade, consisting of ruby silver and stibnite assaying from $40 to $75 a ton. Many expensive and fruitless experiments were made in attempting to treat it, but as far as the records show, no local plant ever succeeded in doing this, although some production was made from ore shipped. The Acacia vein, similar in size to the main or Buckeye vein also gave good assays and was prospected by an adit 200 feet long or more. In later years the company ran a long lower adit to cut the Exchequer and I. X. L. ore bodies at greater depth. This adit was run 4400 feet up to 1888 and was then apparently abandoned. It was designed to be 8500 feet long and would have given a depth of 2000 feet under the outcrops of ore.

I. X. L. Mine was near the Exchequer and on one of the same veins. The discoverers of this mine in 1861 are said to have taken over $50,000 from a space 40 feet long and 22 feet high, within 50 feet of the surface. In 1863, 1000 tons milled are said to have averaged $250 a ton by assay and to have milled $125 a ton.

Development of the I. X. L. from the north drift of the 200-ft. level of the Exchequer vertical shaft was going on in 1875 but was evidently later given up and work devoted to the long adit mentioned above.

Work on the *Wolf Creek Mine,* a prospect of high grade gold ore mentioned in the 1920 report, is being continued. The owners are developing the mine by their own labor, working during the summer months. Some work has also been going on this summer near Woods Lake, not far from the Jackson road. None of the numerous old gold claims elsewhere in the county have shown any recent activity.

COPPER MINES.

As a matter of history, it is interesting to record that the first copper mine worked in the state was the *Uncle Billy Rogers Mine* located in the Hope Valley district in this county, near the Amador County line. Although the metal had been previously reported from other parts of the state by Dr. John B. Trask, the first production was from here in 1855. The ore was described as 'beautiful ore, rich in garnets.'

Alpine Fairview Mine. Wm. Scheele, owner, Gardnerville, Nevada. This group contains 11 claims, unpatented, on Fairview Mountain less than a mile from the California-Nevada state line and two miles from the Woodfords-Gardnerville road. Elevation is 7000 to 7300 feet.

A ledge averaging ten to fifteen feet wide is said to have been traced 1050 feet, striking northwest and dipping west. Samples from the adit carry a porous, rusty gossan with a good showing of malachite, indicating that they have not yet passed below the leached zone.

The claims were bonded in 1920 by the Tri-State Mining and Development Company of Reno. They are said to have sold $23,000 worth of stock. Early in August, 1922, the owner brought suit to recover possession, alleging the agreement had not been fulfilled.

Since 1920 the adit near the mountain top has reached a length of 165 feet entering the ledge from the northeast and following it. Only a few assays have been made, indicating up to 30% copper, according to Scheele. One half ton of ore yielded at the rate of $40 a ton at smelter, including gold at the rate of $4 a ton. The present freight rate to the smelter is about enough to absorb the profits. A so-called gold ledge is a reef of quartzite dipping east and said to carry gold. It is expected to meet the copper ledge in depth.

The property was idle when visited. It is 2000 feet or more above the floor of Carson Valley and could be well opened by adits to that depth. There is a new camp building on the claims.

Morning Star Mine has been described in past reports. In November, 1920, the Griffin Company of San Francisco began work and continued until April, 1921.

After cleaning out the 480 level adit for 1000 feet this company continued the level straight ahead nearly north for over 700 feet, passing under the heavy iron stained outcrop near the face. Peter Curtz, manager for the owning company, reports this adit crossed a vein of gold, silver and copper ore one-foot wide and assaying $16 a ton in gold and silver and 3% copper, at a point 1600 feet from the portal. He considers this a feeder, coursing in the direction of the heavy outcrop to the northwest, and possibly making into a larger ore body thereunder. This vein was not followed. The face of this adit when work ceased is supposed to have nearly reached the north line of a faulted zone, north of which it was hoped to find more enargite ore. A short distance from this feeder, a crosscut was turned eastward, and was carried about 400 feet to the East Ledge, but possibly not through it. No drifting was done on this ledge. There is a showing of ore reported here, as well as at the north face, where Curtz claims there is 3 ft. of good enargite ore.

On the upper or 200-ft. level, the old adit was opened and 225 feet of new work was done, running N. 22° E.; passing just beyond the north line of fault and for a short distance beneath the outcrop. This crosscut is a broken formation 24 feet wide carrying lumps of enargite. Curtz thinks 30 to 40 feet of work on this level would be required to get ore, and 75 feet on the 480 level from the face would put it directly below the upper level and 250 feet deeper. The heavy outcrop continues 300 to 400 feet north of the faces of these adits, offering good inducement for prospecting.

During their tenure the last company erected several new buildings. The surface improvements now consist of boarding house and bunk house for 35 men, two new cottages, garage, office and compressor house. The mine is connected by a pole line with the power plant on East Carson River, furnishing power for nearly nothing. The mill, intended for testing purposes, contains a Huntington mill of 50 tons capacity, 3 slime concentrators, 2 sand concentrators and 2 six-ft. belt vanners. There is enough timber on hand for a year's work or more.

SUMMARY AND CONCLUSION.

The system of prospecting and mining by adits has been used so much in this county that one can not help asking if it has not been overdone. This is an ideal method of mining cheaply. At the same time, when ore bodies are so rich and irregular in distribution as those in Alpine County, and where there is such an abundance of electric power to be had at small cost and where time is such an important factor due to natural conditions, other methods might be better. The maxim of following the ore might be applied with better results than have been had by taking long shots by driving expensive adits.

Except for the fissure veins of quartz in the granite area of the high Sierras, the prospector sees little on the surface to guide him except the immense silicified outcrops which have often marked the approximate location of ore beneath.

Several good geologists have considered it possible that zones of secondary enrichment may occur at depths not heretofore explored. The best method to prospect for such ore would probably be by drilling, guided by known bodies of primary ore already worked, and by structural features.

Production in the past, and the size of ore odies found, compared with the total amount of work done, might induce the belief that the mines have not made a good showing. However, as mentioned above, the fault may lie in the method of prospecting and the lack of experience with such ores, as well as in the need of a local plant equipped for reducing refractory ores. At present there is no mine in the county with sufficient ore proved to justify such a plant. The county's future in mining depends upon the entry of some company with enough money to first prospect for, and if possible, develop some good sized ore bodies. Past history and present developments give ample encouragement for such work.

With a local plant capable of treating the complex ores of the county, a good dead of ore could be worked that is not sufficiently high grade to haul to smelters outside.

Only a few of the mines of the county have been mentioned here, and these principally to illustrate the character of ore deposits. Fuller details on many properties that have been idle for many years, may be had from the works named below:

Bibliography of Geology and Mines of Alpine County.
Raymond, R. W. Statistics of Mines and Mining in the States West of the Rocky Mountains, 1870–1875.
Reports of the State Mineralogist of California:
  Eighth Report, 1888.
  Fifteenth Report, 1915.
U. S. G. S., P. P. 73, Tertiary Auriferous Gravels of the Sierra Nevada, Waldemar Lindgren.
U. S. G. S. Folio 31, Pyramid Peak.
U. S. G. S. Topographic Sheets, Markleeville and Dardenelles quadrangles.

SAN FRANCISCO FIELD DIVISION.

E. S. Boalich, Chief Mining Engineer.

Mariposa County.

The XVII Report of the State Mineralogist contains a detailed description of the mines in Mariposa County. The field work for that report was carried on in 1919 and 1920. Since then mining has been rather quiet in that section, although occasional instances of new activity have been recorded in various chapters of 'Mining in California' since January, 1922.

In the latter part of July and during the first week in August (1922) the Bureau representative visited most of the mining districts in the county and it is encouraging to note that interest is being revived in many mining properties here at the southern extremity of the Mother Lode.

There are forty-one mines in the county equipped with mills of some description. Many have been idle for so long that they are probably almost valueless. However, that gives somewhat of an idea as to what the mining industry was here and what its possibilities might be again. Practically no depth has been reached in this section as compared with the mines in Amador and other portions of the Mother Lode. In many instances the mines here closed when the value dropped to figures that are now considered pay ore.

At the present moment there are only two of the forty-one mills, above mentioned, active: the Original, at Clearing House on the Merced River, and the Virginia Belmont, about four miles south of Coulterville on the road to Bagby.

Quite recently the bridge across the river at Bagby was completely destroyed by fire and until that structure is rebuilt certain districts south of the river will be set back, as they depend on the Yosemite Valley Railroad on the opposite side of the river, for freight and supplies.

The loss of this bridge also cuts off travel between Mariposa and Coulterville, the two chief towns in the County. To make the trip now, a circuitous and rough route must be taken via Merced Falls and Pleasant Valley, a distance of sixty odd miles as compared with about twenty-five miles via Bagby.

Among the properties that are being developed, or have been reopened since the county was last visited, are the following:

Bobbie Mining Co., Geo. S. Cowdery, general manager, Cathay, California, Jas. M. Rowland, superintendent. Located in what is known as the Moore Hill District about three miles east of Cathay post office. Planada, a station on the Santa Fe in Merced County is the nearest railroad point, eighteen miles distant. The company holds one claim formerly known as the Rich, adjoining the Francis, which operated successfully for some time and upon which there still stands a 10-stamp mill that has been idle for over twelve years.

Upon the Bobbie property there are three parallel veins with diorite on both the foot and the hanging walls. They have been traced for several hundred feet along the strike, and the principal one, according to the management, contains an ore shoot about nine feet wide and values for the length of a 200-foot drift have averaged over $12. This ore is a heavy sulphide, and a mill is being erected to treat it by a new process worked out by A. E. Vandercook of Sacramento. The principal crushing unit is a 50-ton ball mill and the contractors have put up a bond to guarantee its completion by November 1, 1922.

B. V. D. Mining Co., A. E. Vandercook and P. L. Drew et al., owners, Cathay, California, is located about half a mile southwest of the Bobbie and on a parallel vein.

The country rock and character of the ore are also similar to that of the Bobbie property, and a 50-ton mill, for which the machinery is on the ground, is being erected. They will also use the Vandercook process. The B. V. D. is a recently developed prospect and is not the rehabilitation of an old mine.

Benton Mill, at Bagby, on the Merced River, was completely destroyed by fire in the winter of 1921. This plant formerly treated ore from the famous Pine Tree, Josephine, and other mines on the northern end of the Fremont Grant.

Little Wonder Mining Co., T. E. Clark, manager, situated near Hites Cove. Ten men said to be employed in doing development work. Property not visited.

Mariposa Mine. Owned by Kelso, Holmes et al., who purchased the south half of the old Mariposa Grant late in 1921. This is one of the most important 'Grant' properties, which was formerly a large producer, but which has been idle for years. Situated at the town of Mariposa. It is reported that negotiations are under way whereby this mine is expected to be sold to Thos. Carpenter, representing Utah capital.

Princeton Mine. This is the principal mine included in the southern portion of the 'Mariposa Grant' purchased some time ago by Messrs. T. E. Kelso, W. H. Holmes and associates. Work of blocking out ore in the mine has been underway during recent months and at present the old 40-stamp mill is being moved to a new position where ore from the mine can be handled more efficiently and economically.

Quail Mine, eight miles southeast of Coulterville, described in detail in the XVII Report of the State Mineralogist (p. 134), is being examined by Eastern parties who contemplate purchasing the property. A total depth of seven hundred feet has been reached in these workings and, according to the present owner, there is 30 inches of $14 ore on that level.

Ruth Pierce Quartz Mine. Located four miles east of Hornitos. Jas. A. McMahan, superintendent. This well known old property, which is fully described in XVII Report (p. 136), is reported to be undergoing repairs with a view to resumption of operations. It is fully equipped with a 10-stamp mill in which electric power is utilized.

San Domingo Quartz Mine. Owned by Wm. S. Zeller, Mariposa, California. Located in Colorado District, eight miles northeast of Mariposa. Has been bonded to L. R. Johnson of Ahwahnee, who is planning to erect a small stamp mill to treat the ore which, so far as developed, has all been free milling. This mine, also known as the Buffalo in times past, is further described in the Seventeenth Report, p. 136.

Simpson Mining Co. W. A. Bradley, superintendent. Has bonded the old Honeycomb, St. Gabriel, and Silver Lead Mines in the Quartzburg District near Hornitos. Some development work has already been undertaken and the 5-stamp mill on the Silver Lead property is being overhauled to handle ore from any portion of the combined claims. Details relative to the latter mine are given in the Seventeenth Report, p. 138.

Texas Hill Mining Co. includes the old Carrie Todd and adjoining claims in the Kinsley District, Secs. 7 and 9, T. 3 S., R. 18 E., M. D. M., on the North Fork of the Merced River. Under the management of C. W. Frazier of Coulterville, this property has been active in carrying on development work for the past year. A 10-stamp mill is practically completed and future prospects look most encouraging. The Seventeenth Report of the State Mineralogist (p. 109) contains details regarding character of the deposit, etc.

White Oak Mine. (Formerly known as Stud Horse Flat Group.) Described in the Seventeenth Report (p. 139), and in 'Mining in California' for April, 1922 (p. 144).

Recent development included the driving of a 200-ft. adit, which at the time the property was visited had just struck the vein. A width of five feet was exposed in the face with no sign, as yet, of the hanging wall. The ore is quartz carrying considerable sulphides. Free gold was noted in several samples taken at random across the vein. John P. Carroll, Bagby, California, owner.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Los Angeles County.

Feather-Stone Insulation Co. This company was incorporated in 1921 to exploit a deposit of diatomaceous earth, located at Covina, and manufacture from same a variety of heat insulating products.

GEOLOGY.

The deposit now being opened by the Feather-Stone Insulation Company at Covina, was discovered in 1918, and is a typical example of the pure siliceous accumulations of the middle Tertiary and belongs to the later Puente formation, a series of Miocene sandstone, shales and diatomaceous earth, which extend from the Puente Hills south to the Santa Ana River, and west and north to the southern base of the San Gabriel, San Rafael, and Santa Monica mountains (U. S. Geol. Survey Bull. No. 309, pp. 103–5).

The Puente series no doubt represents post Vaqueros sedimentation, which took place in the Puente Hills and Los Angeles region throughout the Miocene times. At the end of the Miocene there was a long period of erosion, during which the soft and very light diatomaceous earth deposits were almost entirely removed. On this eroded surface, at the beginning of the Pliocene, the Fernando formation was deposited, serving in some cases as a protection to the soft, underlying beds of diatomaceous earth that had escaped obliteration. The basal conglomerates of the Fernando, which serves as a horizon marker in many places, contain fragments of the opalized diatomaceous earth, similar to the streaks now found in all of the bodies of this material.

After the Fernando series was deposited, there followed a period of uplifting, folding and faulting, which has governed the topography of the whole region. Subsequent erosion has exposed in a few places remains of one great bed of organic sediment of the Miocene. The hills in which the Feather-Stone deposits are located are of such a nature. They are made up almost entirely of diatomaceous earth, and lie in two gentle folds that terminate abruptly against an almost vertical fault, which marks the eastern boundary of the deposit. To the west the beds are thinner and in places covered with a capping of Fernando conglomerate.

The underlying material of the entire deposit is a buff-colored clay, interbedded with streaks of fine sandstone. These clays are diatomaceous in character, 50 per cent of their mass consisting of the same class of siliceous remains, which later furnished the entire bulk of the overlying strata. The line between the buff-colored clays and the pure diatomaceous earth is, however, clearly defined, there being an abrupt change from the clay to the pure white diatomaceous earth that forms the overlying deposit of which more than 300 feet have been exposed by erosion. Of this mass the lower white beds, which are very pure, grade gradually into the upper 'Grey' beds, which contain less silica and more lime and alumina.

The development work, which consists of pits, tunnels, open cuts, and quarry faces, has proven the beds of material to be continuous and homogeneous. At the eastern end of the deposit, tributary to quarry No. 1, there has been proven an area 1500 ft. long and 500 ft. wide, with an average depth of 125 feet. Allowing 80 cubic feet to the ton, this area would yield more than a million tons of high class material, which can be easily and cheaply mined and delivered to a mill erected on the property, or to trucks for hauling to wherever processed.

PLANT.

The company has erected the first unit of a treatment plant, having a capacity of 30 tons a day, and so built that the capacity may be readily increased as business warrants.

The material, after being quarried in open faces passes over a grizzley, and is then trammed in mine cars to a roll crusher. From crusher it goes through a direct heat rotary dryer. From dryer it passes through a Gruendler mill. From the Gruendler mill it is conveyed to cyclones and baghouse. Provision is made to collect material, ranging from 8 pounds to 20 pounds per cubic foot.

GENERAL.

The company proposes to specialize on the manufacture of high temperature insulation material and also on a straight bulding material.

The softer varieties, high in alumina and lime, like the upper beds of the Feather-Stone deposits, are to be used in the making of a high-class heat insulating medium, which, when moulded into brick form and properly burned, yields a porous, two-pound, strong, non-heat conducting brick that retains its shape and size, without shrinking or checking, through all temperatures, to 2000° F.

The hard varieties, crushed to sizes from 1/16- to 3/4-inch mesh, when bound together with cement, will make a substitute for cinder concretes, suitable for use in floors, roofs, or covering for steel columns, wherever lightness and fire-proofing are required. As an aggregate for building one-story houses, its use would ensure cheap fire-, heat- and cold-proof structures.

The company maintains offices at 606 Pacific Finance Building, Los Angeles. Robert Burham, Jr., is president and general manager of the company; J. C. Specht, vice president; R. W. Cole, secretary; D. F. Meiklejohn, superintendent.

The West Coast Asbestos Co., located at Downey, has developed a business of great potential possibilities, in the manufacture of asbestos products. These products include asbestos yarn, cloth, tape, woven brake lining (Emsco), clutch facings, rope, and valve stem and sheet packings, wicking, gaskets and high pressure packing. It uses asbestos obtained from the mines of Canada, Africa, Arizona and California, depending on the particular quality required. It can readily be seen that if the California asbestos mines can furnish a product equal to the Canadian, it will replace the latter.

The increasing uses to which asbestos is being put, as a result of the demand for fireproof material, has opened up a large market for asbestos products, and those deposits in California which possess a commercial grade of asbestos, should begin to find a market for their product.

San Bernardino County.

RANDSBURG DISTRICT.

California Rand Silver, Inc. The following data has been abstracted from the July report of this company:

“Regular dividend No. 31 of 2 cents a share, or a total distribution of $25,600, was made, this making 56 cents a share for the year, or a total of $716,800.”

As the shares have a par value of $1, it means the stockholders of this company, who bought at par, have received a return of 56% this year.

MINE DEVELOPMENT.

‘Reports from the mine are most encouraging, and augur well for the future. On the north drift, eighth level (806 drift), after development through 300 feet of milling ore, two small ledges of very high-grade material have been encountered, and the belief is that the drift will make shipping ore within a short time.

‘The vast body of ore disclosed in the 806 is situated on the Uranium No. 7 claim. This claim, it will be recalled, was jumped by the ‘Coyote’ Company some months ago. Later, the superintendent of the company notified our general manager to cease work on this property. What steps the Coyote may take in the future on behalf of its pretended right to the ground is problematical. But in that connection stockholders are urged to attend the annual meeting September 14, to the end that directors be chosen who believe and will contend that this ground is the property of the California Rand Silver, which it unquestionably is. The Coyote Company has even now filed protest against the issuance of patent to us.

‘The development north on the third, fourth, sixth, seventh, and ninth levels is very promising. Great bodies of milling ore have been exposed. A fair grade of shipping ore has been encountered on the sixth level, and the mine management is hopeful that shipping ore will be found on the other levels named, within the month.

‘On the ninth level south (913 drift) the cut has been through fine milling ore for the last 100 feet, with values lately increasing from $50 to $67. The coming month promises some very interesting developments in our property, according to every present indication.

Ore Extraction and Advancement.

‘There was extracted in July tonnage as follows:

Shipping ore	1098 tons
Milling ore	4505 tons
Waste	3049 tons

‘The total footage was as follows:

Drifts	1000 feet
Crosscuts, raises, shafts, etc.	536 feet
Total	1536 feet

Excellent Progress at Mill.

‘The mill is making gratifying progress, 252 tons of concentrates having been shipped during July, the returns from the smelter from concentrates being $74,376.

Total ore milled in July	4380 tons
Average gold heads in July	$1 66 ton
Average silver heads in July	14 60 ton
Total average value	$16 26 ton
Average gold tails, July	$0 41 ton
Average silver tails, July	1 08 ton
Total average value tails	$1 49 ton
Average gold extraction	75.30%
Average silver extraction	92.60%
Recovery per ton	$14 77
Average concentrate value	310 00 ton
Concentrates produced	208.68 tons

For the first six months of 1922, the following figures are significant:

Ore shipped to smelters (net or dry)	6095.67 tons
Concentrates shipped to smelters (net or dry)	457.52 tons

Gross gold value	$33,416 86
Gross silver value	945,847 81
Gross value of gold and silver	$979,264 67
Net value gold	$30,321 70
Net value silver	718,076 42
Net value gold and silver	$748,398 12

Financial.

The receipts from smelter during July were:

From ore	$81,786 54
From concentrates	74,376 55
Total	$156,163 09

The company, after payment of dividend, has cash on hand of $383,036, as follows:

Legal defense fund	$100,000 00
Tax reserve fund	80,000 00
Other interest-bearing accounts	51,680 00
Credit at smelter	42,736 00
Commercial account	108,620 00
Total cash	$383,036 00

The above data, which we have given in rather full detail, should prove of especial interest to all intending investors in the Randsburg District.

To the average man or woman, they should do more to call attention to the richness of Randsburg than the get-rich-quick type of advertising, which is so much in vogue.

Randsburg Silver Mining Company (Coyote). In order to test the ground with a view of determining the depth and thickness of the formations of the Foster Group, the Coyote Company proposes to put down several diamond drill holes.

The first diamond drill hole is to be put down in the bottom of the Foster shaft, located on Kelly No. 1 claim. This shaft is now down 450 feet and with 1000 feet of diamond drilling from the bottom, much valuable information will be obtained regarding the mineralization of this particular section.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. COLLOM, State Oil and Gas Supervisor.

From July 8, 1922, to and including August 12, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well	Field
KERN COUNTY:					
Coalinga-Kern Oil Company	14	20	14	6	Coalinga
Pacific Oil Company	35	30	24	8	Elk Hills
Pan American Petroleum Company	2	31	24	2-G	Elk Hills
Pan American Petroleum Company	2	31	24	9-G	Elk Hills
Pan American Petroleum Company	2	31	24	15-F	Elk Hills
Pan American Petroleum Company	3	31	24	1-K	Elk Hills
Pan American Petroleum Company	2	31	24	3-G	Elk Hills
Standard Oil Company	32	30	25	3	Elk Hills
E. A. Clampitt	36	28	27	5	Kern River
A. W. Hunt	2	29	28	7	Kern River
Atlantic and Pacific Oil Company	20	30	22	1	McKittrick
Potter Oil Company	6	30	22	1	McKittrick
Potter Oil Company	6	30	22	P. N. 1	McKittrick
Conservative Oil Company	32	31	24	1	Midway
Consolidated Mutual Oil Company	28	31	23	17	Midway
Globe Petroleum Corporation	28	32	24	2	Midway
Murvale Oil Company	12	32	23	M-13	Midway
Pacific Oil Company	27	31	23	17	Midway
Pacific Oil Company	7	32	24	33	Midway
B. B. and O. Oil Company	28	12	24	28	Sunset
C. J. Berry	34	12	24	12	Sunset
Garner-Madison Oil Company	34	12	24	9	Sunset
McCutcheon Oil Company	2	11	24	9	Sunset
Tannehill Oil Company	34	12	24	22	Sunset
Western Minerals Company	17	11	23	14	Sunset
Hodgman Lease	28	25	27	1	------------------
Shale Hills Development Company	35	26	18	1	------------------

Company	Sec.	Twp.	Range	Well	Field
LOS ANGELES COUNTY:					
Apex Petroleum Corporation	29	4	12	2	Long Beach
Bona Fide Oil Syndicate	30	4	12	1	Long Beach
R. R. Bush Company	19	4	12	1	Long Beach
E. B. Campbell	30	4	12	2	Long Beach
Dabney Oil Syndicate	19	4	12	14	Long Beach
Dabney Oil Syndicate	19	4	12	18	Long Beach
Dabney Oil Syndicate	19	4	12	16	Long Beach
Dabney Oil Syndicate	19	4	12	17	Long Beach
de Lendrecie Oil Company	19	4	12	1	Long Beach
Duplex Petroleum Corporation	30	4	12	1	Long Beach
El Paso Pacific Oil Syndicate	29	4	12	1	Long Beach
General Petroleum Corporation	19	4	12	2	Long Beach
General Petroleum Corporation	19	4	12	3	Long Beach
George F. Getty	30	4	12	3	Long Beach
Hall-Weber Syndicate	29	4	12	1	Long Beach
Henderson Petroleum Syndicate	29	4	12	1	Long Beach
Henderson Petroleum Syndicate	19	4	12	1	Long Beach
Henderson Petroleum Syndicate	20	4	12	1	Long Beach
Edward Hericks	24	4	13	7	Long Beach
Hub Oil Company	19	4	12	1	Long Beach
Hub Oil Company	24	4	13	1	Long Beach
Hughes Drilling Company	30	4	12	1	Long Beach
Industrial Oil Syndicate No. 2	19	4	12	1	Long Beach
W. M. Keck	20	4	12	1	Long Beach
W. M. Keck	20	4	12	Klein 1	Long Beach
Liberty Oil Syndicate	19	4	12	1	Long Beach
Carl Maier	19	4	12	1	Long Beach
Marine Oil Corporation	29	4	12	4	Long Beach
Louis Melczer	20	4	12	4	Long Beach
E. J. Miley	19	4	12	1	Long Beach
Pacific Corporation	20	4	12	1	Long Beach
Pacific Corporation	20	4	12	8	Long Beach
Pacific Corporation	20	4	12	9	Long Beach
Petroleum Midway Company, Ltd.	19	4	12	1	Long Beach
Petroleum Midway Company, Ltd.	19	4	12	Davidson 1	Long Beach
Republic Petroleum Company	20	4	12	1	Long Beach
Rice Ranch Oil Company	19	4	12	1	Long Beach
Shell Company	20	4	12	2	Long Beach
Shell Company	29	4	12	Horsch 2	Long Beach
Shell Company	20	4	12	1	Long Beach
Shell Company	19	4	12	2	Long Beach
Shell Company	29	4	12	2	Long Beach
Temescal Oil Company	19	4	12	2	Long Beach
Transport Oil Company	30	4	12	2	Long Beach
United Oil Company	19	4	12	1	Long Beach
Western Star Oil Company	19	4	12	Lewis 1	Long Beach
Western Star Oil Company	29	4	12	1-A	Long Beach
Western Star Oil Company	30	4	12	1-A	Long Beach
Western Star Oil Company	19	4	12	Neece 1	Long Beach
Wigle & McBride	20	4	12	1	Long Beach
Fullerton Oil Company	8	4	14	1	Redondo
Amalgamated Oil Company	5	3	11	4	Santa Fe Springs
Bellview Oil Company	6	3	11	1-A	Santa Fe Springs
Coalinga Mohawk Oil Company	6	3	11	1	Santa Fe Springs
Thos. Donley Land and Oil Co.	6	3	11	1	Santa Fe Springs
Elliott Petroleum Corporation	1	3	12	1	Santa Fe Springs
Farmers and Merchants Trust Co.	19	3	11	1	Santa Fe Springs
General Petroleum Corporation	6	3	11	52-A	Santa Fe Springs
General Petroleum Corporation	6	3	11	78	Santa Fe Springs
General Petroleum Corporation	6	3	11	91-A	Santa Fe Springs
General Petroleum Corporation	6	3	11	77	Santa Fe Springs
General Petroleum Corporation	5	3	11	53	Santa Fe Springs
George F. Getty	6	3	11	4	Santa Fe Springs
George F. Getty	5	3	11	2-A	Santa Fe Springs
George F. Getty	5	3	11	5	Santa Fe Springs
Oscar R. Howard	6	3	11	1	Santa Fe Springs
C. C. Julian Company	6	3	11	2	Santa Fe Springs
E. A. Lamb	6	3	11	1	Santa Fe Springs
Petroleum Producers Syndicate	6	3	11	1	Santa Fe Springs
San Diego-Santa Fe Springs Syn.	6	3	11	1	Santa Fe Springs
Santa Fe Springs Mutual Oil Syn.	6	3	11	1	Santa Fe Springs
Shell Company	31	2	11	1	Santa Fe Springs
Standard Oil Company	6	3	11	1	Santa Fe Springs
Standard Oil Company	6	3	11	3	Santa Fe Springs
Standard Oil Company	6	3	11	2	Santa Fe Springs
Standard Oil Company	6	3	11	Johnson 1	Santa Fe Springs
Standard Oil Company	31	2	11	2	Santa Fe Springs

Company	Sec.	Twp.	Range	Well	Field
LOS ANGELES COUNTY—Cont'd.:					
Twin Bell Oil Syndicate	6	3	11	3	Santa Fe Springs
Union Oil Company	6	3	11	3	Santa Fe Springs
Union Oil Company	6	3	11	11	Santa Fe Springs
Union Oil Company	6	3	11	15	Santa Fe Springs
Universal Consolidated Oil Co.	5	3	11	1	Santa Fe Springs
C. Bell	25	1	13	1	------
California Pacific Oil Company	24	1	13	2	------
Jos. L. Herron	1	1	13	1	------
Potter Oil Company	18	3	13	1	------
Union Oil Company	35	2	14	1	------
Burt T. Wells	18	1	18	1	------
MENDOCINO COUNTY:					
Mendocino-Midway Oil Syndicate	30	19	13	1	------
NAPA COUNTY:					
Sugar Loaf Oil Association	------	8	3	1	------
C. V. Wreden	------	8	3	1	------
ORANGE COUNTY:					
Union Oil Company	12	3	10	54	Brea Olinda
Amalgamated Oil Company	34	5	11	2	Huntington Beach
Amalgamated Oil Company	34	5	11	6	Huntington Beach
Amalgamated Oil Company	34	5	11	4	Huntington Beach
Argonaut Oil Company	11	6	11	1	Huntington Beach
General Petroleum Corporation	2	6	11	1	Huntington Beach
Holly Oil Company	35	5	11	1	Huntington Beach
Lindsay Equitable	11	6	11	1	Huntington Beach
Miley Keck Oil Company	34	5	11	19	Huntington Beach
Miley Keck Oil Company	2	6	11	16	Huntington Beach
Miley Keck Oil Company	2	6	11	11	Huntington Beach
Miley Keck Oil Company	2	6	11	21	Huntington Beach
Petroleum Midway Company, Ltd.	35	5	11	3	Huntington Beach
Petroleum Midway Company, Ltd.	35	5	11	4	Huntington Beach
Rhoads Oil Producing Company	11	6	11	7	Huntington Beach
Standard Oil Company	2	6	11	2	Huntington Beach
Standard Oil Company	2	6	11	7	Huntington Beach
Standard Oil Company	2	6	11	15	Huntington Beach
Standard Oil Company	3	6	11	1-A	Huntington Beach
Union Oil Company	34	5	11	3	Huntington Beach
Union Oil Company	30	3	9	21	Richfield
RIVERSIDE COUNTY:					
Cabazon Oil Company	9	3	3	1	------
SAN BERNARDINO COUNTY:					
Arrowhead Development Company:	24	3	6	1	------
SANTA BARBARA COUNTY:					
Cuyama Petroleum Company	6	10	27	1	------
SAN MATEO COUNTY:					
Berger & Caglieri	Purisima Rancho			1	------
VENTURA COUNTY:					
I. W. Keerl	32	2	20	1	Conejo
R. C. Worsdell	8	4	21	1	Ojai
R. B. K. Petroleum Company	18	4	18	1	Piru
Shell Company	28	3	23	5	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

PROGRESS REPORT ON PLACER GOLD INVESTIGATION.

By Chas. S. Haley.

The work during the month of July has been largely confined to the channels of the ancient tertiary rivers, which lie on the headwaters of the Yuba and American rivers of the present day.

Commencing above the Mohawk Valley, on the ridge dividing Jameson Creek and the east fork of Nelson Creek, both tributary to the Feather River, there is a channel, which is still very largely virgin, and in many places is heavily lava-capped. There are excellent opportunities for drifting on this channel. Coming down from the McCray Ridge, it passes underneath Rattlesnake Peak, and down through Monte Cristo, above Downieville. Here it crosses to the City of Six and proceeds southerly to Forest and Alleghany, by way of Chips Flat to Moores Flat, and joins the main channel at the Derbeck Mine, above North Bloomfield; in the region of Alleghany and Chips Flat, this channel has been well drifted. At Moores Flat, there are several hundred feet of good, hydraulic gravel, which will be of great value, in case hydraulic mining is resumed, under the proper limitations.

Another channel, commencing above Table Rock, in the Blue Nose and Bunker Hill country, comes down by way of Eureka to White Bear, and also passes southwest of the Forest and Alleghany channel, along Kanaka Creek and through the Grizzly Ridge, probably joining the main channel somewhere near the region of Backbone House. This channel, also, has much virgin ground, and, judging by what work has already been done on it, there should still be an opportunity for profitable drifting.

Another channel, starting near Gold Lake, back of the Sierra Buttes, comes down across the North Fork of the Yuba, by way of Milton, and passes through American Hill and Snow Point, joining the main channel of the Tertiary Yuba, somewhere above Relief Hill. This channel has been drifted more than the other two, but still has some ground which appears promising. A tributary to this channel from the Graniteville region is very uncertain in its course, but where it has been worked has proved profitable.

In the region north and east of Forest Hill, there is a territory, which, as yet, has been very little investigated. The heavy rhyolite flows at the close of the Eocene period were responsible for the removal of these channels, but in the upper regions there is still a considerable quantity of the old Cretaceous white gravel, deposited before the turning of this channel from its northward course, down through Todds Valley. On many of these branch channels, particularly above the Ralston Divide, there has been a great deal of money taken out, as a rich pocket country was cut down and concentrated by these channels.

A detailed investigation of this section will be undertaken during the months of September and October of this year, and it is hoped that some interesting and possibly profitable ground will be within the scope of this report during the months of October and November.

VALUATION OF MINING AND OIL PROPERTY.*

By Fletcher Hamilton.

When requested by Mr. Ralph Smith of your body to address you upon the subject of valuation of mining and oil property, the invitation was accepted through a desire to be of some service to your membership but, I promise you, with slight realization of the task confronting anyone who might attempt to present a solultion of those problems in which you are so vitally interested and which you, no doubt, have before you continuously.

Valuation of any property, in so far as the State's interest is concerned, is made with the sole purpose of taxing that property for state, county or municipal revenue.

In order that taxation may be just and equitable, it is mandatory, in the interest of justice, that a uniform basis of valuation be adopted for the guidance of those who are charged with the duty of appraising property. If this could be done, the question of tax rates would be simple.

The measure of value of property is governed by the degree to which it is able to produce revenue. The very nature of mining and oil properties places them in a class different from the ordinary real estate, agricultural and other properties, in that every ton of ore or barrel of oil produced reduces the value of that property to that extent. In other words, these industries are known as wasting industries.

It can, therefore, be seen that every individual mining and oil property is a problem unto itself and its value is dependent upon a thorough investigation of its ore or oil reserves, as the case may be.

In the case of the mine, the ore reserves are accurately measurable in so far as they can be considered developed, and at any particular date the value of the mine may well be taken as the net value of the ores developed, measurable and salable on that date.

In the case of oil, we have a much more difficult problem to face and one which introduces a wealth of variable factors. This will be discussed later on.

The mine valuation is made up of practically two factors, Surface Improvements and Net Value from Ore Reserves.

First: Surface Improvements.

As a matter of fact, surface improvements on a mine have little value aside from their usefulness in allowing the owner of the mine to derive the net value from its ores which forms the basis of the mine valuation. It is well known, to those familiar with mining operations, that an idle plant is worth but a small percentage of its original cost when offered for sale. However, when a mine is operating and producing, the same basis of valuation as is placed upon similar property in other industries would probably be just and equitable.

Second: Net Value from Ore Reserves.

Where it is necessary to expend capital and labor in order to produce value, that value is measurable by deducting the cost of production from the gross value of the product. This applies decidedly to the mine.

---

*Paper read before the State Tax Appraisers Convention, Los Angeles, California, 1922.

The measurement of ore bodies, the sampling and determination of marketable values therein are decidedly technical processes and must be employed to determine the gross value of a mine.

The operating costs, chargeable against and deductible from the gross value, should include all items of expense entering into the production of the final marketable commodity, namely: cost of mining and development, cost of milling, freight and other treatment costs, all general and office expense such as taxes, insurance, salaries of active officers and managers at plant and headquarters; also proper deductions for depletion and depreciation should be made according to the life of the property.

Various methods of valuation have been evolved and proposed, but one method of valuation for all purposes seems to be impossible. The value of a mine for state purposes, the value of a mine for federal purposes, and the value of a mine for the buyer's or seller's purposes are different things. Even the value of a mine for various purposes of the state or county are different.

In the valuation of a mine for taxation purposes, it is desired to place such valuation on a basis comparable with or equitable as to other property. In the valuation of a mine for inheritance tax purposes, it is necessary to arrive at a valuation as of a particular date and which would be a valuation equal to a sale value of a given property, provided there was a demand or market for that property. In all these cases, however, an equitable basis should be provided, and that, undoubtedly, is the net value of ore reserve basis for inheritance tax purposes and net value of ore production basis over a given period for ordinary taxation purposes.

In June, 1920, I served on a committee on valuation in a case of a large copper property wherein the company petitioned the Board of Supervisors for a reduction in the valuation of the property as made by the Assessor.

The committee had available a mine model, maps of mine workings, as well as access to all records of tonnages and values, ore reserves, also mining and smelting costs. All of the ore bodies were checked with stope maps by underground inspection. The grade of the ore was established and checked by the smelter operation records and the value of the ore reserves established, allowing for a smelter loss as shown by the operation records.

The value of copper in the ore was established by taking the average market quotations for a period of ten years previous to the date of valuation.

To illustrate the variable factors: the mining and transportation costs had increased from $2.93 per ton in 1914 to $4.66 in 1918 and the smelting and refining costs had increased from $4.25 per ton in 1914 to $7.91 per ton in 1919.

From the records, it was established that the operating costs, not taking into consideration depreciation and depletion, were $12.21 per ton and the ore reserves were established at $16.04 per ton, thus leaving a net value per ton of $3.83, upon which basis the ore reserves were calculated in giving the mine its valuation.

It was reported also by the committee that the ore reserves would operate the smelter for a period of only six to eight months and that, inasmuch as the mine equipment and camp buildings were of value only as long as the property was operated, this should be taken into consideration.

The committee further reported that, as a matter of assessment policy, possessory rights in unpatented and undeveloped mining claims would be fairly assessed to prospector or location holder at $2.50 per acre and where ground is held, under mineral patent, $5 per acre. In case of successful development, additional assessment proportionate to ore values created, could be placed.

In the matter of valuation of equipment on this property, an interesting point is worth mention. This had to do with a large and costly experimental plant which could not produce a profitable product and was idle. The committee was of the opinion that until the plant was a proven commercial success, its actual cash value for assessment purposes should be based on conditions as they existed, which would be what the machinery and material could be sold for after dismantling; in other words, that experimental work should not be excessively assessed by high valuation of plant.

In review then, the mine valuation consists of, first, its surface equipment and improvements. Its main and essential value, however, lies in its proven ore reserves. In the calculation of the value of these reserves we have variable factors, namely, varying cost of production due to adverse or more favorable operating conditions; also a varying market price for the commodity product, except in the case of gold mines.

I have not dwelled upon the possible or probable ores in the mine for the reason that this constitutes the speculative value of a mining property and involves the judgment of the engineer or geologist upon whose judgment capital is willing to invest in order that real values may be produced.

The subject of mine valuation and taxation is one which is being given considerable attention and I am taking the liberty of including herewith a few paragraphs of a letter from Albert Burch, a well known mining engineer, to the Secretary of the California Metal and Minerals Producers Association, as follows:

> DEAR SIR: I recommend that the Committee on Taxation ask the Executive Committee and members of the Association to support the following uniform plan of mine taxation for California:
>
> FIRST. *Assessment.*
>
> Valuation for assessment for purposes of local taxation as follows:
>
> A. Surface improvements on the same basis as other property in the county in which they are located.
>
> B. The value of mining claims and real estate, the surface of which is not used for other than mining purposes, at one quarter of the gross value at the mine of all ores, minerals or metals produced during the preceding year provided, however, that should the net value of such production exced one-fourth the gross value, then the net value should be taken as the value of the mining claims and real estate. The net value should be determined by deducting from the gross value:
>
> 1st. The actual cost of mining and development work performed during the year.
>
> 2nd. The actual cost of freight and treatment on the ore.

3rd. General expenses, including taxes, insurance, welfare work, cost of workmen's compensation, office expenses at both mine headquarters, and salary of all officers engaged in the actual operation or management of the business of the mine.

4th. Depreciation to the amount of the actual decrease in value of the surface plant, where its value is not fully maintained by repairs and betterments and where so maintained, the cost of such repairs and betterments.

5th. Allowance for depletion in accordance with the provisions of the U. S. revenue laws.

SECOND. *Tax Levy.*

A. For local (county and municipal) taxes, the levy should be the same as for other classes of property in the same county, district and municipality.

B. For state taxation the levy should be one-half of one per cent on the value of the net proceeds for the preceding year and this should be in lieu of any franchise tax whatever.

My reasons for advocating the above described plan are partly those of justice and partly of expediency.

The present haphazard method is objectionable, because of lack of uniformity throughout the state and because too much latitude is given to the discretion of county assessors who are usually much more familiar with the value of other property than they are with that of mines. Most California mines are located in counties where interests other than mining have the preponderance of influence, and without some controlling law, the natural tendency of the county officer, no matter how honest and capable, is to favor those having the most political influence. On the other hand, in the rare instances where mining is the leading industry, county officers are liable to show it undue favoritism.

It is therefore in the interest of justice that the valuation of mines for assessment purposes be put upon a uniform basis throughout the state, and this highly technical matter be taken, once for all, from the hands of the inexperienced.

That many others have arrived at the same conclusion is evidenced by the fact that the following named states, in which mining is one of their important industries, have passed special laws for the assessment and taxation of mines:

Arkansas
Arizona
Colorado
Idaho
Michigan
Minnesota
Montana
Nevada (constitutional)
New Mexico
New York
Oklahoma
South Carolina
Utah
Wyoming

The laws of the above named states, covering the subject of mine taxation, are by no means uniform but nearly all of them provide some method by which the assessment of mining property is taken out of the hands of local assessors.

The plan which I have outlined above is very similar to that adopted by the State of Colorado at the last session of its legislature which supplants a law previously in force in that state that provided for a much higher valuation on mining property. The history of the industrial development of and the present condition of Colorado are very similar to those of California. Starting originally as a mining state, there has been a gradual growth of: first, stock raising, then agriculture, then general commerce and finally manufacturing; and today, each of the last three named industries far outweighs mining in importance within the state. And it is since the relegation of mining to a position of secondary importance in the state's industries, that special laws for mine taxation have been adopted by Colorado.

Taking up the valuation of oil properties:

In referring to my previous statement that each oil and mining property is a problem unto itself—in the case of the mine, the ore is accurately measurable; in the case of the oil reserve, however, an estimate only can be made and the degree of worth of that estimate is proportional to the completeness to which the particular property has been drilled.

The net value of an oil property is dependent upon amount of oil available, cost of extraction and price; none of these factors is fixed, and property valuation must fluctuate. The actual amount of oil under a property may change due to its migratory nature. The amount of oil recoverable varies with the degree of efficiency in operating methods. Extraction costs vary with changes in cost of labor and supplies. Changes in the market price of oil are frequent. It might be well to note here that within the last thirty days there have been two cuts of 25 cents each in the price of oil at the wells in California which now places 14° gravity to 19.9° gravity oil at a price of 60 cents per barrel, with higher gravity oils at a graduated increase.

The valuation of oil land is made upon the knowledge of past performance of the wells in the tract of land to be considered. The more complete the record, the greater the degree of comparative accuracy in the estimate of value to be made.

The determination of extractable oil content in land depends upon the thickness of oil sands, porosity, viscosity of oil, and gas pressure. These factors have not been fully recorded but cognizance must be taken of them.

The gross production records by individual wells in a given tract are most important and from such records curves showing the variation in rate production have been developed, which, over a period of years, give a fair idea of what may be anticipated in a particular property. It has been found generally that after its flush production, a well gradually declines in production. It is also noted that each additional well drilled into the oil measure lowers the production of adjacent wells. As a tract becomes more completely drilled, the initial or flush production becomes smaller.

So-called 'settled production' has been well established as the basis for valuation of oil land.

As in the case of the mine, an oil property can only be valued by the net value from oil reserves basis.

Chief cost of oil production consists of five factors: (1) Cost of land or drilling right; (2) Surface plant equipment; (3) Drilling of wells; (4) Maintenance of property; (5) General expense.

The time element in draining a given oil measure is important in the valuation of a property. Operating obstacles also make a great difference in items of cost. It is undoubtedly good business to write off, as operating costs, a large depreciation and depletion charge annually.

With a condition wherein so many variables enter, it seems that valuation of oil properties for state purposes should be based entirely upon known factors of production with as little of the variable elements entering as possible.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Summary of Operations, California Oil Fields, April, 1922, Vol. 7, No. 10.
Mining in California, June, 1922, (Monthly), Vol. 18, No. 6.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
XIV Report State Mineralogist	9
XV Report State Mineralogist	9
XVII Report State Mineralogist	13
Mines and Mineral Resources of Colusa, etc.	7
Mines and Mineral Resources of Del Norte, etc.	7
Mines and Mineral Resources of Fresno, etc.	9
Mines and Mineral Resources of Imperial, etc.	8
Mines and Mineral Resources of Alpine, etc.	8
Mines and Mineral Resources of Butte, etc.	7
Mines and Mineral Resources of El Dorado, etc.	10
Mines and Mineral Resources of Inyo, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	7
Mines and Mineral Resources of Mono, etc.	1

Publications	Number distributed
Mines and Mineral Resources of Monterey, etc.	10
Mines and Mineral Resources of San Bernardino, etc.	13
Mines and Mineral Resources of Nevada County	13
Mines and Mineral Resources of Plumas County	12
Mines and Mineral Resources of Sierra County	13
Bulletin No. 6, California Gold Mill Practices	11
Bulletin No. 23, Copper Resources of California	6
Bulletin No. 37, Gems, Jewelers' Materials, Ornamental Stones of California	12
Bulletin No. 46, Index to Mining Bureau Publications	6
Bulletin No. 50, Copper Resources of California (Revised Edition)	6
Bulletin No. 67, Minerals of California	2
Bulletin No. 72, Geologic Formations of California	17
Bulletin No. 76, Mining Laws, United States and California	9
Bulletin No. 78, Quicksilver Resources of California	10
Bulletin No. 85, Platinum and Allied Metals in California	13
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	112
Mining in California, (Monthly) Vol. 18, No. 5, May	2300
County Maps and Registers of Mines	35
El Dorado Forest Map	8
Madera Forest Map	7
Placer Forest Map	9
Shasta Forest Map	7
Sierra Forest Map	8
Siskiyou Forest Map	8
Tuolumne Forest Map	8
Inyo Geological Map	10
Forest Map, unmounted	6
Forest Map, mounted	7
Geological Map of California, mounted	16
Geological Map of California, unmounted	5
Colored Map accompanying Bulletin No. 89	21
Oil Field Maps	448

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 691 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

California produces commercially at least fifty different mineral substances, with a total annual value in recent years of nearly $250,000,000. There are several thousand operating properties, including mines, quarries, oil and gas wells, mineral springs, salt works, gravel pits, mills and smelters.

Some data relative to the 1921 production has been given in 'Mining in California,' beginning with the April issue, and additional substances are covered herein. The completed figures for the remaining items and the final summaries by groups and counties will be published in the September issue.

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV. Bulletins 38, 67.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915. Some amblygonite, a lithium phosphate, has also been obtained from pockets associated with the gem tourmalines. In 1920 there was a marked drop in the yield of lepidolite, the output being utilized in glass manufacture. As there was only a single producer, the figures are concealed under the 'unapportioned' item. The average value reported was $15.24 per ton, f.o.b. rail-shipping point.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1916	71	$1,065
1900	440	11,000	1917	880	8,800
1901	1,100	27,500	1918	4,111	73,998
1902	822	31,880	1919	800	14,400
1903	700	27,300	1920	10,046	153,502
1904	641	25,000	1921	*	*
1905	25	276			
1906	----------	----------			
1915	91	1,365	Totals	15,851	$380,686

*Concealed under 'Unapportioned.'

According to the U. S. Geological Survey, the only other production of lithium minerals in the United States outside of California in recent years has been spodumene from South Dakota.

MAGNESIUM SALTS.

Bibliography: 'Dictionary of Applied Chemistry,' by Thorpe.
U. S. Geol. Surv., Mineral Res. of U. S.

Magnesium chloride is an important item in certain chemical uses, and in the preparation of Sorel cement in laying magnesite floors. Previous to 1915, Germany was the principal source of this chloride. Some of the salt companies in California began its commercial preparation in 1916, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride.

In addition to the chloride, some magnesium sulphate, or 'technical epsom salts,' has also been made at four of the plants: Oliver Chemical Company in Alameda County, Whitney Chemical Company in San Mateo County, the Marine Chemical Company at Long Beach, Los Angeles County, and the California Chemical Company at San Diego; though but two of them reported sales of the sulphate in 1921. In 1919, the Merle Magnesia Company at Redwood City, San Mateo County, produced magnesium carbonate for use in magnesia-asbestos pipe covering.

In 1921, the prices reported for the chloride ranged from $22 to $36 per ton, and the prices for the sulphate at $23–30.

The 1921 output of chloride and sulphate totaled 4153 tons, valued at $106,140, an increase in tonnage, but a slight decrease in the value from the 1920 figures of 3150 tons and $107,787.

With the use of magnesite cement and stucco coming more into vogue in building construction, the demand for magnesium chloride will increase in proportion.

Metallic magnesium is prepared generally by electrolysis of fused magnesium chloride in a bath of an alkaline chloride. In the United States, one plant uses a bath of salt and ammonium chloride. A plant at Niagara Falls uses calcined magnesite, the metal being reduced by electrolysis of the fused oxide in an electrolyte or bath of fused fluorides. The commonest known use of the metal is in the powdered form for flash lights in photography. During the war, magnesium was put in shrapnel shells, that observers and gunners might know exactly where the shells were bursting. By day the burning magnesium gives a dense pure-white cloud of magnesium oxide, and at night a dazzling white light. Larger quantities were used in aerial bombs and rockets for lighting up the country at night. Magnesium has, as yet, found but a limited direct use as a metal. Magnalium, an alloy of aluminum containing about 2% of magnesium and small percentages of other metals, is stated to be used in automobiles and aeroplanes. The possibilities for further important developments in this direction are promising.

Total Production of Magnesium Salts in California.

The total production of magnesium salts in California since the beginning of the industry here, is shown in the following tabulation:

Year	Tons	Value
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
Totals	11,842	$367,719

MANGANESE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV, XVII, Bulletins 38, 67, 76. U. S. G. S., Bull. 427.

By far the greater tonnage of manganese ore is utilized in the preparation of ferro-manganese and employed in the steel industry both for its metal content and to slag off certain impurities during the open-hearth treatment. Though its other uses may be classed as 'chemical,' the tonnage thus consumed is relatively smaller. Its chemical uses are as a decolorizer or oxidizer in glass manufacture, and as a constituent in electric dry batteries. The chemical uses require a much higher grade of ore than the steel industry. For steel purposes an iron content is acceptable, but manganese should exceed 40%. Silica should be under 8%, though higher was taken during the war period. Phosphorus should be under 0.20%. For electric dry cells, the iron content should be under 1.5% Fe_2O_3, and SiO_2, under 6%. For glassmaking the manganese should be practically free of iron. On account of the high prices prevailing for manganese during 1915–1918, selenium replaced manganese dioxide in glass factories; and it is stated to have been so successful that its use continues.

Though the imports of manganese ore from the Caucasus District in Russia were reduced by the war to practically nothing, the United States received important shipments from Brazil, India and Cuba; so that the total imports for 1916 were practically double those of either 1914 or 1915. The 1916 figures were 576,321 long tons, valued at $8,666,179; for 1917, a total of 629,972 long tons, valued at $10,262,929, of which 512,517 tons were from Brazil; in 1918 a total of 491,303 long tons, value $15,095,867, of which 345,877 tons were from Brazil; in 1919, a total of 333,344 long tons, value $11,229,184, of which 246,592 tons came from Brazil; in 1920 total 601,437 long tons, value $11,955,922, with 421,523 tons, Brazil; in 1921, total 401,354 long tons, $3,365,732, with 262,468 tons, Brazil. Consular reports of January, 1922, indicate that some ore is again being shipped from Trans-Caucasia.

Batteries, chemicals, and kindred industries in the United States consume approximately 25,000 tons of high-grade manganese ore, annually, or about one-thirtieth of that used in steel manufacture.

A considerable portion of the state's 1917-1918 product was utilized in California in making ferro-manganese by electric furnace; besides shipments which were sent East. Some 'chemical' ore was also shipped. For many years the principal producing section has been the Livermore-Tesla District, in Alameda and San Joaquin counties, but exceeded in 1915 by Mendocino and regaining the lead in 1916. In 1918–1920 the largest producing county was Stanislaus, which adjoins San Joaquin on the south, and whose manganese district is a part of the same geological province that includes the Livermore-Tesla District.

Manganese is reported to exist in many localities in the state; but for a number of years, particularly since the discontinuance of the chlorination process in the metallurgy of gold, production was relatively unimportant until the activity of the war period.

The production of manganese ore in California for 1921 amounted to 1005 tons of all grades, having a total value of $12,210 f. o. b. rail-shipping point. This was less than one-half of the quantity, and one-fifth of the value in 1920. The prices paid in 1921 ranged from $6 to $15 per short ton, the average being approximately $12 per ton.

The ores produced in California in 1921 were shipped mainly to plants at Berkeley and Redwood City, where they were concentrated by elimination of the silica. The Consolidated Manganese Company in Berkeley utilizes an electro-magnetic separation. Their product is sold, in part, to iron foundries for use, instead of ferro-manganese, in cupola blast furnaces making gray-iron castings; and, in part, sold for use in the manufacture of pressed, building brick to deepen the color. The American Manganese Products Company at Redwood City refines siliceous manganese ores by a patented chemical process, producing a high-grade, dioxide especially suited for dry-cell electric batteries.

Manganese Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows the California output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1906	1	$30
1888	1,500	13,500	1907	1	25
1889	53	901	1908	321	5,785
1890	386	3,176	1909	3	75
1891	705	3,830	1910	265	4,235
1892	300	3,000	1911	2	40
1893	270	4,050	1912	22	400
1894	523	5,512	1913	------	------
1895	880	8,200	1914	150	1,500
1896	518	3,415	1915	4,013	49,098
1897	504	4,080	1916	13,404	274,601
1898	440	2,102	1917	15,515	396,659
1899	295	3,165	1918	26,075	979,235
1900	131	1,310	1919	11,569	451,422
1901	425	4,405	1920	2,892	62,323
1902	870	7,140	1921	1,005	12,210
1903	1	25			
1904	60	900	Totals	84,099	$2,315,349
1905	------	------			

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	Tons	Value
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

[1]"The different uses to which mica is put depend on its form—whether in sheets or in powder. Sheet mica is used in the electrical industry, for glazing, and to some extent for other purposes. Ground mica is used chiefly in the decorative trades and in insulation.

"Sheet mica finds its greatest use in the electrical industry, where an insulating, noninflammable material is necessary. It is used in sheets and as washers and disks in dynamo-electric machinery, electric-light sockets, spark plugs, insulators, guards in rheostats, fuse boxes, and telephones. Flexible cloth and tape, covered with mica, find varied uses in electrical apparatus. Sheet mica is used for glazing the fronts of stoves and for making lamp chimneys and lamp shades. It is also used in spectacles, automobile shields, phonograph diaphragms, in windows where glass would be broken and in lantern transparencies.

"Ground mica is used for decoration in wall paper, to which it gives luster and brightness; in fancy paints, ornamental tiles, concrete, rubber goods, pipe and boiler coverings, insulating compounds, fireproof paints and coverings, patent roofing material, molded mica (ground mica mixed with shellac), and calico printing; as absorbent for nitroglycerin in the manufacture of 'mica powder,' in tempering steel; to a large extent as a lubricant for wooden bearings, or, mixed with oil, as a lubricant for metal bearings; and as a filler for various products. Tar and other roofing papers are coated with coarsely ground mica to prevent sticking when they are rolled for shipment. A possible value of ground mica as a chemical source of potash salts is indicated in a recent Geological Survey report.[2]

"It is understood that sheet mica has come to be of importance as a war mineral through its use abroad as windows in masks worn for defense against asphyxiating gases, and for other uses where a transparent, noninflammable, nonshattering material is necessary, as in automobile goggles and in windows for armored cars."

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII–XVIII, Inc. Bulletin 38.

Mineral paint materials were produced in California in 1921 from a single property in each of the following five counties: Alameda, Placer, Santa Cruz, Stanislaus, and Ventura. The total amounted to 446 tons, valued at $4,748, being slightly more than one-half the 779 tons and $8,477 of 1920. The decrease was due mainly to smaller shipments of yellow ochre from the Knights Ferry District in Stanislaus County. As in 1920, there were no shipments from Colusa County. The material there is a siliceous hematite. The Santa Cruz product is magnetite concentrated from beach sands. That shipped from Alameda County is a red, ferruginous shale; that from Placer, hematite; and that from Ventura, red ochre.

Besides the above-named counties, deposits of mineral paint have been noted, and in the past most of them have yielded some commercially, in the following: Amador, Calaveras, Imperial, Kern, Kings, Lake, Los Angeles, Nevada, Riverside, Sonoma.

---

[1] Schaller, W. T. Mica in 1916; U. S. Geol. Surv., Min. Res. of U. S., 1916, p. 304, 1917.

[2] Butler, B. S., Potash in certain copper and gold ores, with a note on muscovite by George Steiger: U. S. Geol. Survey Bull. 620, pp. 227-235, 1916.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1907	250	$1,720
1891	22	880	1908	335	2,250
1892	25	750	1909	305	2,325
1893	590	26,795	1910	200	2,040
1894	610	14,140	1911	186	1,184
1895	750	8,425	1912	300	1,800
1896	395	5,540	1913	303	1,780
1897	578	8,165	1914	132	847
1898	653	9,698	1915	311	1,756
1899	1,704	20,294	1916	643	3,960
1900	529	3,993	1917	520	2,700
1901	325	875	1918	728	4,738
1902	589	1,533	1919	1,780	17,055
1903	2,370	3,720	1920	779	8,477
1904	270	1,985	1921	446	4,748
1905	754	4,025			
1906	250	1,720	Totals	17,672	$163,398

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII-XVIII, Inc. U. S. G. S., Water Supply Paper 338. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing. From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of practically any of the world-famed spas of Europe or the eastern United States can be found here.

An interesting development in recent years is the obtaining of 'geyser' wells at Calistoga, in Napa County, by drilling into the thermal-water strata underlying that part of the Napa Valley. There are at present several wells so erupting. They spout in true geyser fashion, and their periods vary from 10 minutes to 2 hours, each following its own schedule rather closely.

It is hoped that the State Mining Bureau will be able in the near future to make some systematic tests as to the radio-activity of the thermal waters of the springs of California. Some preliminary qualitative tests have been made by the writer at The Geysers in Sonoma County, and positive reactions obtained; also, radio-activity has been proven at Arrowhead Hot Springs in San Bernardino County, by Prof. Gilbert E. Bailey of the University of Southern California.

Commercial production of mineral water by counties, in 1921, was as follows:

County	Gallons	Value
Butte	2,900	$4,100
Calaveras	2,809	791
Contra Costa	600,300	6,099
Lake	54,715	26,751
Los Angeles	264,468	13,314
Napa	72,364	55,760
Riverside	56,400	2,945
San Diego	70.924	9,161
Santa Barbara	97,847	133,590
Santa Clara	2,500	275
Siskiyou	250,150	5,015
Sonoma	37.641	9,891
Colusa, Humboldt, Marin, Monterey, San Benito, San Bernardino, San Luis Obispo, and Solano*	1,933,260	99,784
Totals	3,446,278	$367,476

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural, and a large part was used in the preparation of soft drinks with flavors.

Mineral Water Production of California by Years.

Amount and value of mineral water produced in California since 1887 are given herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1906	1,585,690	$478,186
1888	1,112,202	252,990	1907	2,924,269	544,016
1889	808,625	252,241	1908	2,789,715	560,507
1890	258,722	89,786	1909	2,449,834	465,488
1891	334,553	139,959	1910	2,335,259	522,009
1892	331,875	162,019	1911	2,637,669	590,654
1893	383,179	90,667	1912	2,497,794	529,384
1894	402,275	184,481	1913	2,350,792	599,748
1895	701,397	291,500	1914	2,443,572	476,169
1896	808,843	337,434	1915	2,274,267	467,738
1897	1,508,192	345,863	1916	2,273,817	410,112
1898	1,429,809	213,817	1917	1,942.020	340,566
1899	1,338,537	406,691	1918	1,808,791	375,650
1900	2,456,115	268,607	1919	2,233,842	340,117
1901	1,555,328	559,057	1920	2,391,791	421,643
1902	1,701,142	612,477	1921	3,446,278	367,476
1903	2,056,340	558,201			
1904	2,430,320	496,946	Totals	60,815,166	$13,435,267
1905	2,194,150	538,700			

NITRATES.

Bibliography: Report XV. Bulletin 24. U. S. G. S., Press Bulletin No. 373, July, 1918.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of intense interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

PHOSPHATES.

Bibliography: Bulletin 67.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithia phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

A deposit of phosphate rock is reported to have been located near Big Pine in Inyo County.

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII–XVIII. Bulletins 38, 45, 67, 85. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

In California, platinum is obtained mainly as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Shasta and Yuba counties, with smaller amounts from dredges in Amador, Stanislaus and Trinity, and from the hydraulic and surface sluicing mines of Del Norte, Humboldt, Siskiyou and Trinity.

During the last two years, quite a number of prospectors and small operators, working with rockers and panning have recovered amounts of platinum which, though individually small, have in the aggregate added materially to the state's total yield. This is particularly true of the Beegum Creek District in southwestern Shasta County; also the New River and Hayfork districts in Trinity County.

The production of platinum-group metals in California for 1921 totals 869 ounces, crude, containing 613 fine ounces, valued at $58,754. Of this amount, a total of 824 ounces, crude, or 95%, came from the gold dredges. This is an increase of 136 fine ounces in quantity, but a decrease of $10,223 in value compared with the 1920 figures, due to the lower prices prevailing in 1921. An average of approximately $75 per fine ounce was paid for platinum, and around $150 per fine ounce for the iridium content in 1921.

The above-noted total of 613 fine ounces, includes 257 fine ounces of osmiridium and iridium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium and osmiridium or iridosmine, with occasionally some palladium. Some platinum and palladium are also recovered in the electrolytic refining of blister copper. Iron in greater or less amount is always alloyed naturally with native platinum, and usually some iridium and osmium.

For further detailed information on California's platinum resources, analyses, tests, et al., the reader is referred to Bulletin 85, issued by the State Mining Bureau, and to the April issue of 'Mining in California', pages 158-172 *ante.*

In addition, there is usually some platinum recovered as a by-product in the gold refinery of the Mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. The San Francisco Mint is stated to have recovered as high as 100 ounces of platinum in a single year from this source, some of which unquestionably came from California mines.

For 1921, the distribution of California's platinum yield was as follows:

County	Fine ounces	Value
Butte	31	$2,432
Calaveras	12	876
Plumas	18	1,615
Shasta	219	26,817
Trinity	27	3,260
Yuba	179	14,396
Amador, Del Norte, Humboldt, Mendocino, Sacramento, Siskiyou, Stanislaus*	127	9,358
Totals	613	$58,754

*Combined to conceal output of a single operator in each.

Russia, previous to 1916, was producing from 90% to 95% of the world's platinum, but for several years following was reduced to practically nothing; and has not yet recovered her former position. Colombia ranks in second place. California is the leading producer in the United States.

Besides its well-known uses in jewelry, dentistry and for chemical-ware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats, and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

Platinum Production of California by Years.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1906	91	$1,647
1888	500	2,000	1907	300	6,255
1889	500	2,000	1908	706	13,414
1890	600	2,500	1909	416	10,400
1891	100	500	1910	337	8,386
1892	80	440	1911	521	14,873
1893	75	517	1912	603	19,731
1894	100	600	1913	368	17,738
1895	150	900	1914	463	14,816
1896	162	944	1915	667	21,149
1897	150	900	1916	886	42,642
1898	300	1,800	1917	610	43,719
1899	300	1,800	1918	571	42,788
1900	400	2,500	1919	*418	50,611
1901	250	3,200	1920	477	68,977
1902	39	468	1921	613	58,754
1903	70	1,052			
1904	123	1,849	Totals	12,230	$473,590
1905	200	3,320			

*Fine ounces, beginning with 1919.

POTASH.

Bibliography: Report XV. Bulletin 24. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789.

Potash production began commercially in California in 1914, with a small yield from kelp. Considerable time and money has been spent on research work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there has been accomplished on a commercial basis at three plants on Searles Lake.

The imports of potash salts and fertilizers from Germany previous to the European war had an annual value of several millions of dollars, and their cessation made a domestic production imperative. The normal pre-war price of $35 to $40 per ton for high-grade agricultural salts was succeeded by figures of several times those amounts during the period of 1915–1920. Resumption of German imports in 1920 forced the prices down, so that the reports of the 1921 Californian production show sales ranging from $25 to $60 per ton for salts carrying from 35% to 60% equivalent K_2O.

During 1921, a total of 14,806 tons of potash-bearing materials of all grades was produced in California, valued at $390,210, compared with 26,298 tons, and $1,465,463 in 1920. This included refined potassium chloride from salt works bitterns, chloride and sulphate from Searles Lake brines, cement dust and sulphate from cement dust, and molasses distillery slops char. The only yield from kelp in 1921 was from the government plant at Summerland, Santa Barbara County, which also recovered some iodine as a by-product. Some potash char was produced at one plant operating on Hawaiian molasses, but which is not included herein, not being of Californian origin.

The bulk of the 1921 output was utilized in fertilizer preparations, and some was sold for chemical purposes.

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements included tanning, dyeing, metallurgy, electroplating, photography, and medicine.

The following tabulation shows the distribution of the 1921 potash output of California:

County	Product	Equivalent per cent K_2O	Tons	Value
San Bernardino	Chloride and sulphate	38–60	7,202	$211,067
Santa Barbara	Chloride	50	143	5,720
Alameda, Riverside, San Mateo, Santa Clara, Santa Cruz*	Chloride, cement dust, molasses distillery slops char, sulphate	4–59	7,461	173,423
	Totals		14,806	$390,210

*Combined to conceal output of a single operator in each.

Total Production of Potash in California.

The annual amounts and values of these potash materials since their beginning in California in 1914, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
Totals	266,619	$15,966,957

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII. Bulletin 38 (see 'Tufa').

The production of pumice and volcanic ash for the year 1921 amounted to 406 tons valued at $6,310, and came from a single property, each in Humboldt, Imperial, Inyo and San Bernardino counties. This is a decrease both in tonnage and total value from the 1920 yield.

The pumice deposits in Imperial and Siskiyou counties are of the vesicular, block variety, and are practically the only localities in the United States from which commercial production of this grade has been made. There are other known deposits of this variety in Inyo, Madera, and Mono counties. This form is used largely for abrasive purposes; and is also being utilized in fire-brick, and as an insulating filler in the walls of refrigerators and cold-storage plants. It has also been tried in concrete construction. The volcanic ash, or tuff, variety is employed in making scouring soaps and polishing powders. Foreign importations of block pumice come mainly from the Lipari Islands, Italy.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value
1909	50	$500
1910	------	------
1911	------	------
1912	100	2,500
1913	3,590	4,500
1914	50	1,000
1915	380	6,400
1916	1,246	18,092
1917	525	$5,295
1918	2,114	28,669
1919	2,388	43,657
1920	1,537	25,890
1921	406	6,310
Totals	12,386	$142,813

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, V, XII–XV, XVII. Bulletins 27, 78. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227.

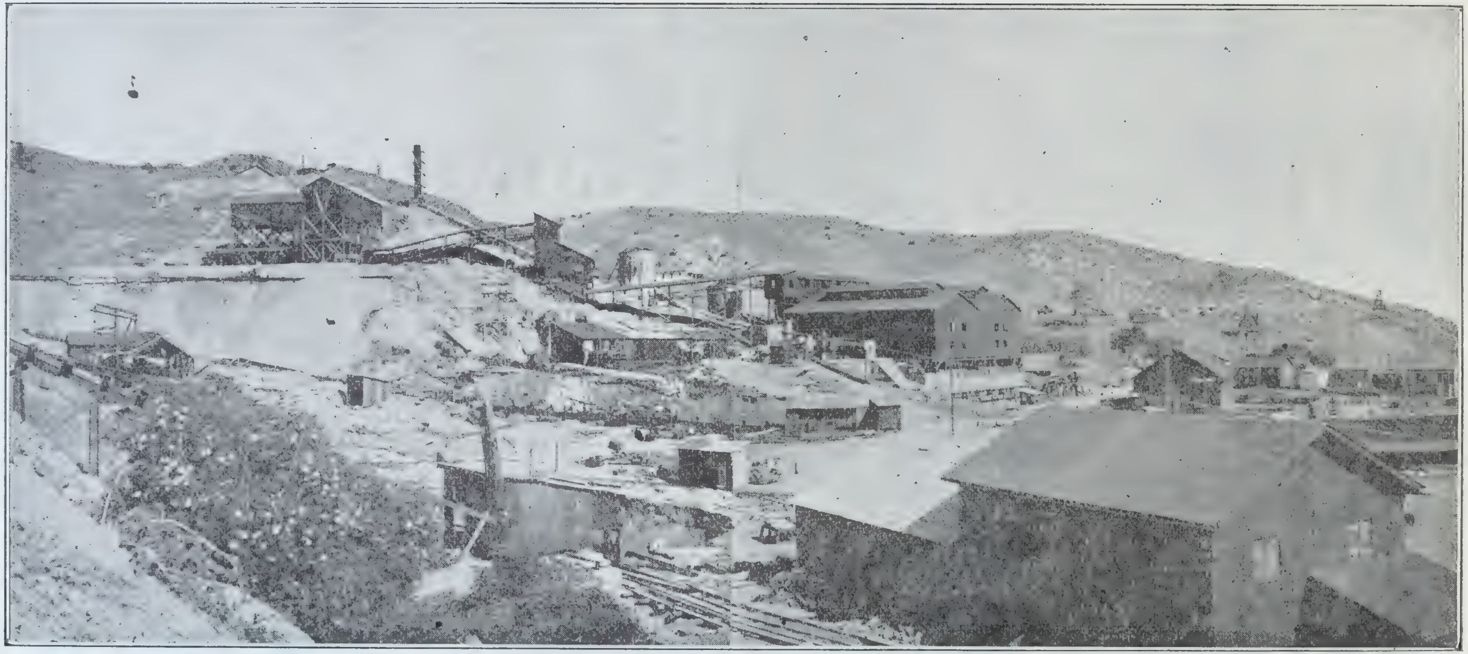
Quicksilver was produced in California in eight counties during 1921, to the amount of 3,157 flasks, valued at $140,666, being a decrease both in amount and value from the 1920 output. This is the smallest number of flasks produced in a year in California since the quicksilver industry began in 1849. The average price received during 1921, according to the producers' reports to the State Mining Bureau, was $44.56 per flask, as against $75.45 in 1920, and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1921 was $47.42 per flask. Quotations ranged from $50 in January and May, and $49.50 in December, down to $40.40 for the month of November.

Because of high operating costs, and foreign importations, practically all of California's important quicksilver producers have been shut down since November, 1920, with the exception of the Senator mine of the New Almaden company in Santa Clara County which has been working steadily, and the Cloverdale Mine in Sonoma, operated intermittently.

As passed by the House, the tariff bill now before Congress placed the import duty on quicksilver at 35¢ per pound, equivalent to $26.25 per flask. The Senate has changed this figure to 25¢ per pound, or $18.75 per flask. This and other differences are now to be taken up by the conference committee of the two houses, and it is hoped, for the benefit of the domestic quicksilver idustry, that the higher figure will prevail.

Quicksilver, though not used in such quantities as is copper or some of the other metals, is not less vital in peace than in war. No completely successful substitute has yet been found for quicksilver in some of its uses. Except during the stimulated production resulting from the high prices of the war period, our domestic output of quicksilver for a number of years has not kept pace with domestic consumption. This is not due to a lack of local sources, but mainly to the competition of low-cost foreign metal dumped onto our market through an almost negligible import duty. Other financial and economic conditions obtaining during the past two years have also had their effect on the situation, but they could have been weathered had it not been that the



Reduction plant of New Idria Quicksilver Mining Co., San Benito County, Cal. Tramway terminals and ore bins at left; furnaces in center; burned ore tailings stacker at right.

lack of tariff protection permitted the too-free entry of foreign metal. There is plenty of ground, even in California, in addition to what may be in Nevada and Texas, that will warrant development if only a fair price can be assured that will justify exploitation. Our domestic quicksilver industry is in danger of complete extinction, if not soon given adequate protection against foreign importation. Manufactured mercurials should also be included in the dutiable tariff list, as a protection to our detonator and drug manufacturers, which would in turn further assist the domestic mines. The manufacturers of mercurial products in the United States should join with the miners in the demand for an adequate protective tariff. We should not short-sightedly 'conserve' our domestic quicksilver resources by forcing them to remain in the ground on account of foreign competition, only to wake up some day, when faced with an emergency, to find that quicksilver mining and metallurgy is a 'lost art' in the United States and can not be revived at a moment's notice. Several months' time is required to properly equip and put in operation a reduction plant, and the knowledge of the art is even at present confined to a limited few.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

One new use for quicksilver is in the introduction of a small amount into the cylinders of steam turbines to improve the vapor pressure and thus increase efficiency. This mercury is recoverable and can be re-used, so that there is only a small proportional loss.

Quicksilver is an absolutely essential element from a military standpoint, as there has not yet been produced an entirely satisfactory commercial substitute for it in the manufacture of fulminating caps for explosives. However, in order to reduce consumption of the fulminate, some potassium chlorate, picric acid, trinitro-toluol, or tetranitromethylamine is sometimes mixed with it. The Ordnance Department of the U. S. Army, during the war, at least, would accept no substitutes, as they have thus far proven unreliable.

New Equipment.

The most notable development in recent years in the metallurgy of quicksilver is the adaptation of the rotary cement-kiln to the reduction of quicksilver ore at the New Idria Mine, San Benito County. They there installed five such furnaces, with a combined daily capacity of 500 tons. The lead of the New Idria Company in the matter of rotary furnaces was followed at the Sulphur Bank Mine, Lake County; Bella Union or Rutherford Mine, Napa County; Cloverdale Mine, Sonoma County, and at the January Mine, Yolo County.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (though the yield was small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1887	33,760	1,430,749	$42 38
1851	27,779	1,859,248	66 93	1888	33,250	1,413,125	42 50
1852	20,000	1,166,600	58 33	1889	26,464	1,190,880	45 00
1853	22,284	1,235,648	55 45	1890	22,926	1,203,615	52 50
1854	30,004	1,663,722	55 45	1891	22,904	1,036,406	45 25
1855	33,000	1,767,150	53 55	1892	27,993	1,139,595	40 71
1856	30,000	1,549,500	51 65	1893	30,164	1,108,527	36 75
1857	28,204	1,374,381	48 73	1894	30,416	934,000	30 70
1858	31,000	1,482,730	47 83	1895	36,104	1,337,131	37 04
1859	13,000	820,690	63 13	1896	30,765	1,075,449	34 96
1860	10,000	535,500	53 55	1897	26,691	993,445	37 28
1861	35,000	1,471,750	42 05	1898	31,092	1,188,626	38 23
1862	42,000	1,526,700	36 35	1899	29,454	1,405,045	47 70
1863	40,531	1,705,544	42 08	1900	26,317	1,182,786	44 94
1864	47,489	2,179,745	45 90	1901	26,720	1,285,014	48 46
1865	53,000	2,432,700	45 90	1902	29,552	1,276,524	43 20
1866	46,550	2,473,202	53 13	1903	32,094	1,335.954	42 25
1867	47,000	2,157,300	45 90	1904	*28,876	1,086,323	37 62
1868	47,728	2,190,715	45 90	1905	24,655	886,081	35 94
1869	33,811	1,551,925	45 90	1906	19,516	712,334	36 50
1870	30,077	1,725,818	57 38	1907	17,379	663,178	38 16
1871	31,686	1,999,387	63 10	1908	18,039	763,520	42 33
1872	31,621	2,084,773	65 93	1909	16,217	773,788	47 71
1873	27,642	2,220,482	80 33	1910	17,665	799,002	45 23
1874	27,756	2,919,376	105 18	1911	19,109	879,205	46 01
1875	50,250	4,228,538	84 15	1912	20,600	866,024	42 04
1876	75,074	3,303,256	44 00	1913	15,561	630,042	40 23
1877	79,396	2,961,471	37 30	1914	11,373	557,846	49 05
1878	63,880	2,101,652	32 90	1915	14,199	1,157,449	81 52
1879	73,684	2,194,674	29 85	1916	21,427	2,003,425	93 50
1880	59,926	1,857,706	31 00	1917	24,382	2,396,466	98 29
1881	60,851	1,815,185	29 83	1918	22,621	2,579,472	114 03
1882	52,732	1,488,624	28 23	1919	15,200	1,353,381	89 04
1883	46,725	1,343,344	28 75	1920	10,278	775,527	75 45
1884	31,913	973,347	30 50	1921	3,157	140,666	44 56
1885	32,073	986,245	30 75				
1886	29,981	1,064,326	35 50	Totals	2,188,984	$106,841,606	--------

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as those who utilize the facilities of the collection.

During the month a total of 656 visitors signed their names to the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

Frank Sanborn, Petrologist.

There were 278 samples received and determined during the thirty-day period covered by this report. Among this number there were but few of special scientific interest. The public are showing a live and increasing desire to find good deposits of the non-metals and salines, and the outlook in that field is promising.

A list of samples of possible commercial value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–232	Hydrous aluminum silicate, apparently halloysite; also talc-schist.
05–233	Copper-cobalt ore, with a very little nickel.
05–234	Pumice; block and small size lump.
05–235	Kaolinized material; probably a pottery clay.
05–236	Clay; does not burn white.
05–237	Clay; probably a fire clay.
05–238	Diatomaceous earth; also gypsum and calcite.
05–239	Diatomaceous earth.
05–240	Talc; also soapstone.
05–241	High grade copper ore; also lead-silver ore.
05–242	'Soap rock,' montmorillinite group; also volcanic ash (silica)
05–243	Diatomaceous earth, impure; also limonite.
05–244	Barite; impure.
05–245	Copper ore; commercial.
05–246	Scheelite.
05–247	Diatomaceous earth, with some volcanic ash.
05–248	Clay; fairly high grade.
05–249	Asbolite; cobalt-bearing manganese oxide.
05–250	Clay (Fuller's earth).
05–251	Quartz.
05–252	Graphite with clay.
05–253	Copper ore; also chalcedony.
05–254	Chrysotile asbestos.
05–255	Lignite coal; fair quality.
05–256	Arsenopyrite.
05–257	Limonite (ochre).

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geol. Survey:
- Bulletin No. 736–C—Geology of the Wiles Area Ranger District, Texas. By Carroll E. Dobbin.
- Bulletin No. 735–D—Silver Enrichment in the San Juan Mountains, Colorado. By Edson S. Bastin.
- Carbon Black Produced from Natural Gas in 1921. By E. G. Sievers.
- Lead in 1921. By C. E. Siebenthal and A. Stoll.
- Fluorspar and Cryolite in 1921. By Hubert W. Davis.
- Manganese and Manganiferous Ores in 1921. By H. C. Jenison.
- Potash in 1921. By M. R. Nourse.
- Gold, Silver, Copper, Lead and Zinc in Colorado, 1920. By Charles W. Henderson.
- Asbestos in 1920. By Edward Sampson.
- Lead and Zinc Pigments and Salts in 1921. By C. E. Siebenthal and A. Stoll.
- Slate in 1921. By G. F. Loughlin and A. T. Coons.
- Gold and Silver in 1920. By J. P. Dunlop.
- Phosphate Rock in 1921. By K. W. Cottrell.
- Water Supply Paper No. 500—Contributions to the Hydrology of the United States, 1921. By Nathan C. Grover, Chief Hydraulic Engineer.

U. S. Bureau of Mines Reports of Investigations:
- Serial No. 2361—The Spring Canyon Mine Rescue Association. By A. L. Murray (Car Surgeon, U. S. B. M., P. A. Surgeon (R), U. S. Public Health Service).

Serial No. 2362—Additions, Removals and Changes in Permissible List of Explosives from March 15 to May 31, Inc., 1922. By S. P. Howell (Explosive Engineer, B. M.).

Serial No. 2363—Helium. By R. B. Moore (Chief Chemist, B. M.).

Serial No. 2364—Properties of Typical Crude Oils from the Producing Fields of Oklahoma. By E. W. Dean, A. D. Bauer, M. B. Cooke and C. R. Bopp.

Serial No. 2365—Ignition of Coal Dust by Electric Arcs. By L. C. Ilsley (Electrical Engineer, B. M.) and E. J. Gleim (Associate Electrical Engineer, B. M.).

Serial No. 2366—Oklahoma Promotes Safety in Coal Mines. By D. J. Parker (Chief of Mine Safety Service, B. M.).

Serial No. 2367—Official Approval of Burrell Methane Indicator. By L. C. Ilsley (Electrical Engineer, U. S. B. M.).

Serial No. 2368—Temperature-Pressure Curves of Petroleum Products. By H. B. Cooke (Assistant Refinery Engineer, B. M.).

Serial No. 2369—Explosives Used in April, 1922. By W. W. Adams (Statistician, U. S. B. M.).

Serial No. 2370—Fatalities at Coal Mines in May, 1922. By W. W. Adams (Statistician, U. S. B. M.).

Bulletin No. 182—Carbon Black; Its Manufacture, Properties and Uses. By R. O. Neal and G. St. J. Perrott.

Technical Paper 263—Design and Operation of a Low-Pressure Absorption Plant. By W. P. Dykema and A. A. Chenoweth.

Technical Paper 285—Compressed Air Illness and Its Engineering Importance. By Edward Levy.

Technical Paper 302—Coal Mine Fatalities in the United States, 1921. By William W. Adams.

Technical Paper 313—Production of Explosives in the United States During the Calendar Year 1921. By William W. Adams.

Bureau of Standards Circular No. 120—Construction and Operation of a Simple Homemade Radio Receiving Outfit.

Scientific Paper No. 433—Thermal Expansion of a Few Steels. By Wilmer Souder (Physicist) and Peter Hidnert (Associate Physicist, B. of S.).

Annual Report of the Territorial Mine Inspector to the Governor of Alaska. By B. D. Stewart, Territorial Mine Inspector, and B. W. Dyer, Federal Mine Inspector.

Geological Survey of Georgia, Bulletin No. 39—Historical Sketch of the Geological Survey of Georgia. By H. S. Cave, Asst. State Geologist.

State of Idaho Bureau of Mines and Geology, Bulletin No. 4—Petroleum Possibilities of Certain Anticlines in Southeastern Idaho. By Virgil R. D. Kirkham.

State of Idaho Bureau of Mines and Geology, Bulletin No. 5—Geology and Ore Deposits of Alturas Quadrangle. By S. M. Ballard.

Report of Appraisal of Mining Properties of New Mexico. By J. R. Finlay.

Societies and Educational Institutions.

Smithsonian Institution, United States National Museum:

Bulletin No. 104—The Foraminifera of the Atlantic Ocean. By Joseph Augustine Cushman.

Bulletin No. 31—Contributions from the United States National Herbarium. Vol. XXIII, Part II. Trees and Shrubs of Mexico. By Paul C. Standley.

Bulletin of the Institution of Mining and Metallurgy, July, 1922.

The Mining Congress Journal, August, 1922.

Canadian Institute of Mining and Metallurgy, August, 1922.

The Philippine Journal of Science, March, 1922.

The American Mineralogist, July, 1922.

Journal of the American Peat Society.

Books.

Coal. By Elwood S. Moore, M. A.

The Mines Handbook, 1922.

Maps.

U. S. Geol. Survey Topographic Sheets:
- Carbon, Cal.
- Charleston School, Cal.
- Custer, Idaho.
- Elk Garden, W. Va.-Md.
- Gregg, Cal.
- Kentucky Well, Cal.
- Kotsina-Kuskulana, Alaska.
- Lanes Bridge, Cal.
- La Sal Vieja, Texas.
- Moorefield, W. Va.
- Ortigalita, Cal.
- Oxalis, Cal.
- Petersburg, W. Va.
- Quien Sabe, Cal.
- Stockbridge, Mich.
- Waldport, Ore.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Brick and Clay Record, Chicago.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Hercules Mixer, Wilmington, Delaware.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Georgetown Gazette, Georgetown, Cal.
Gateway Gazette, Beaumont, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Humboldt Standard, Eureka, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oroville Daily Register, Oroville, Cal.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Plumas National Bulletin, Quincy, Cal.
Plumas Independent, Quincy, Cal.
Placer Herald, Auburn, Cal.
Petroleum Reporter, Etna Mills, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Stockton Record, Stockton, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–101 Gypsum deposit.
02–102 Manganese deposit.
02–103 Hydraulic gravel deposit in Siskiyou County; equipped.
02–104 Asbestos (chrysotile).
02–105 Gold mine; 450 acres patented, free water power and some equipment; Nevada County.
02–106 Silica sand and soda ash.
02–107 Operating brick and tile property; has large reserves of clay shale.
02–108 Asbestos (chrysotile).
02–109 Barite deposit; high grade and white.
02–110 Gold quartz claims in Shasta County; free and base ore; has produced.
02–111 Coal mine; will sell or bond.
02–112 Dolomite marble deposit in San Diego County; close to transportation.
02–113 Drift gravel mine; 8 claims; open for inspection; will sell on easy terms.
02–114 Pyrite ore carrying enargite (arsenical copper ore) and some gold; 32-mile haul to railroad.

Mineral Products or Deposits Wanted.

03–97 Gypsum deposit of large extent and good quality.
03–98 Gypsum, chalk, halloysite, barite and ochre; deposits or tonnages.
03–99 Arsenopyrite or arsenical ore; tonnage.
03–100 Limestone deposit in one of southern coast counties.
03–101 Colemanite; tonnage.
03–102 Amphibole asbestos deposits.
03–103 Sulphur deposit; prefer one that can be quarried.
03–104 Arsenical ore; tonnage.
03–105 Copper-zinc ore deposit; 'complex' ore.
03–106 Limestone deposit on or very close to salt water.

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–30 Mill Superintendent. General milling experience; amalgamation, cyanidation, flotation; gold and silver particularly. Competent assayer. Age 34; married. Salary wanted, $250 and quarters.

01–31 Geologist-Engineer. Technical graduate, petroleum engineering. Five summer vacations spent in oil-field work. Age 23; single. References. Salary wanted, $150–$200.

01–32 Mine Superintendent. Technical education. Twenty years experience covering lode, placer, drift, and hydraulic mining; operation, construction, field work, drilling. Age 46; married. References. Salary open.

SEPTEMBER, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS

REDDING FIELD DIVISION.

W. B. TUCKER, Mining Engineer.

Shasta County.

GOLD MINES (operating).

Double Header Mine. It is situated two miles west of Tower House, in section 33, T. 33 N., R. 7 W., in the French Gulch Mining District.

Holdings consist of Sawpit Placer claims No. 1 and No. 2, South Star Quartz mine and 80 acres of patented land in S. ½ of N.W. ¼ of section 33, totaling 140 acres. Owners: Chas. Garrett, J. A. Pepper of Tower House, W. P. Donnelly and W. W. Treat of Anderson.

The property was reopened in February, 1922, by Chas. Garrett and associates. The development work has been confined to a quartz vein which occurs along a fault fissure in the meta-andesite. The vein strikes N. 15° W., and dips 55° east; width 4 to 6 feet. There are two other veins on the property, which have a general east and west strike, and dip to the north about 45°. One of these east and west veins occurs on the contact between the black slate and meta-andesite, and lies 150 feet north of the present workings, on the Double Header vein. This vein has a width of 2 to 4 feet, and dips with the contact. The other east and west vein is south of the portal of the lower tunnel and shows prominent croppings of quartz, in the meta-andesite. On this latter vein outside of few shallow open cuts, and short tunnels, there is no development to speak of. At an elevation of 1500 feet, a tunnel has been driven north 400 feet on the Double Header vein.

The vein developed in this tunnel shows from 4 to 6 feet of quartz, which carries some free gold and iron pyrite. At 175 feet from the portal of the tunnel, a crosscut has been driven 100 feet, on a small quartz stringer which strikes S. 60° E. and dips 70° south. A number of short upraises have been made in this tunnel on the vein. The owners propose to drive the present tunnel ahead to cut the vein which occurs on the contact between the meta-andesite and slate. Some ore is being stoped near the portal of the tunnel, which is reported to have a value of $10 to $20 per ton. At a higher elevation, there are a number of short tunnels on the vein, which have been stoped out to the surface. Equipment: Blacksmith shop, cars, and tools. There is a two-stamp mill on the property. Two men employed.

El Dorado Mine. The property is situated one-fourth of a mile southwest of Tower House, in section 3, T. 32 N., R. 7 W. in the French Gulch Mining District. Holdings consist of 40 acres of patented land. The mine is owned by James G. Conner of Redding; under lease to Messrs. Statton and Van Slyke of French Gulch. Discovered in 1885. Worked for past seven years, 1912 to 1919. The workings are on the steep slope of a ridge north of Mill Creek at an elevation of 1500 feet. The lode lies along a fault contact of meta-andesite and black slate, striking N. 20° W. and dipping 35° east. Along the slate hanging wall, quartz occurs in lenses up to 2 feet in width. Occasionally the quartz is found in the meta-andesite close to the contact and usually mixed with fragments of andesite. Manganese stains are quite common in the quartz, which is oxidized.

Ore is mostly free milling, but some pyrite is associated with it. Numerous fine specimens showing free gold through the quartz have been taken out. Development work consists of a main adit tunnel, 450 feet long, driven northwest on the lode. At 250 feet from the portal of the tunnel, a winze has been sunk, on the vein 50 feet, with a drift north on the vein 26 feet. Here the vein varies from 2 to 3 feet in width. At the face of the drift the vein is cut off by a fault.

At 340 feet from the mouth of the tunnel there is an upraise 30 feet in ore. It is stoped out here for a length of 50 feet to top of raise, then the vein flattens and values disappear. It is reported that $4,000 was taken out of this raise. The gold occurs entirely in pockets in the quartz. Equipment: Blacksmith shop, tools, and bunkhouse and a two-stamp mill (850-lb. stamps) with triple discharge mortar and amalgamation plates, operated by 8-h.p. Fairbanks Morse Gas Engine. Two men employed.

Reference: State Mineralogist Report XII, page 247; XIII, page 355.

Gold Leaf Mine. This property is situated four miles west of Redding, in section 5, T. 31 N., R. 5 W., in Lower Springs Mining District. Elevation 900 feet.

Holdings consist of four claims: Gold Leaf, Gold Bronze, Summit, and North End; 80 acres. The property is owned by the Gold Leaf Mining Company, Ira Judson Coe, president, Mills Building, San Francisco.

A series of parallel northeast and southwest veins, and also north and south veins which intersect the northeast and southwest veins, east and west of shaft, occur in meta-andesite and slate. The width of veins varies from 2 to 6 feet. Veins dip 65° to the east. The quartz carries free gold with iron pyrite, but most of the values occur with the pyrite.

Development: Vertical shaft 400 feet deep, with levels driven north and south on the vein at intervals of 100 feet. A drain tunnel 224 feet long intersects the shaft on the 120-foot level. Drifting on each level amounts to 150 feet. Stoped from 300-foot level to surface near the shaft.

The ore shipped is reported to have carried $8 to $15 per ton. Equipment: Consists of 25-h.p. direct connected electric hoist. Electric power is furnished by the Pacific Gas and Electric Company.

The shaft is being retimbered, and the mine unwatered. Four men are employed. E. L. Anderson, superintendent.

Reference: State Mineralogist Report XIII, page 358.

Milkmaid and Franklin Mines. They are situated on the north side of French Gulch, in section 17, T. 33 N., R. 7 W., 3 miles northwest of the town of French Gulch.

Holdings consist of eight claims known as: Franklin, Milkmaid, Summit, Ibex, Buckeye, Virginia, Peggy and May-Day; totaling 150 acres. The Franklin mine is reported to have been located in 1852, and the Milkmaid shortly afterwards. Total production of the two mines is reported to be $2,500,000 and from 1910 to 1922, the production was $496,000. Most of the development work is confined to the Franklin and Milkmaid claims.

Franklin workings: Two veins have been followed to some extent in the Franklin workings; one with a strike of N. 5°–30° W., and a steep dip to the east, the other with a strike of approximately E. and W. and a dip of about 70° N.

The wall rocks are slate and soda-granite porphyry. The veins are near the contact and cut both rocks, but tend to be best developed in the porphyry, fingering out in the slates.

The Franklin is developed by two adit levels, at elevations of 1950 and 2055 feet.

The Franklin or upper tunnel, driven N. 60° E., in porphyry, at 200 feet from the portal cuts the north and south vein, which dips 60° east. This vein above the tunnel level flattens to 45° and when within 30 feet of the surface, straightens up to 70°. Width of vein varies from 12 inches to 4 feet. The elevation of the Geiser tunnel is 1950 feet. It is a crosscut tunnel driven N. 60° E., following a fault fracture, and cuts the north and south vein at 450 feet from the portal. On this level the vein has been followed for a distance of 700 feet.

The Milkmaid workings: The Milkmaid joins the Franklin on the east. The rocks in the vicinity consist of soda-granite porphyry, diorite porphyry and slate. Both porphyries are intrusions in the slate. At an elevation of 1900 feet, the lower Milkmaid tunnel is a crosscut 220 feet to the vein, and is driven 50 feet beyond the vein, a total distance of 270 feet.

The vein strikes N. 10° W., and dips 80° east. On No. 1 level, the vein is drifted on, 150 feet north and 55 feet south.

The upper Milkmaid tunnel is a crosscut tunnel, 100 feet to the vein, with drifts 150 feet north on the vein and 25 feet south. On No. 2 level, the shaft level, drifts extend 300 feet south on the vein from the shaft and 100 feet north. About 200 feet north of the crosscut tunnel an incline shaft has been sunk to a depth of 200 feet. On No. 3 level there is a drift 150 feet south on the vein from shaft. No. 1 level is 50 feet below the upper tunnel level; No. 1 to No. 2 level is 100 feet, and No. 2 to No. 3 level is 70 feet. In these workings, the vein varies from few inches up to 4 feet of quartz; above the upper workings on the Milkmaid and Franklin veins, extremely rich oxidized ore was taken out. The gangue minerals of the vein are quartz and calcite. Much of the quartz presents a faintly mottled grayish appearance due to enclosed wall rock. The sulphides in the ore are arsenopyrite, pyrite, galena and sphalerite. The sulphides amount to about 0.75 per cent of the weight of the ore, and carry $150 to the ton in gold. The ore in the main vein runs from $20 to $45 per ton and is in irregular pay shoots that probably pitch steeply to the south. The best ore is found where the vein is in the prophyry close to the slate contact.

Mine equipment: Consists of compressor plant, blacksmith shop, and bunk houses.

Reduction equipment: Consists of 10-stamp mill (1100-lb. stamps), 4 Frue vanners; driven by electricity. Owner: Western Exploration

Company (H. F. Musser), of Redding. Under lease and bond to Capt. H. E. Smith of Shasta, California. Roy Leach, superintendent. Eight to ten men are employed on the property.

Bibliography: U. S. Geol. Survey Bull. No. 40, pp. 35, 61, 63, 64. State Mineralogist Report XIV, p. 793.

Reid Mine. It is situated eight miles north of Redding, in section 3, T. 32 N., R. 5 W., in Old Diggins Mining District; elevation, 1700 feet.

Holdings consist of 160 acres; a patented quarter-section.

There are a series of parallel auriferous quartz veins, striking almost due north and south, with steep dips, slightly to the east, in meta-andesite. The veins are large, varying from 6 to 30 feet in width, and very persistent. Gold values vary from $4 to $30 per ton. Development in recent years has been confined to the main vein. This has been opened on five levels, greatest length of pay chute was 400 feet; and maximum width 30 feet. Workings consist of 1100-foot vertical shaft, and main adit about 1000 feet long. This cut the shaft at the 300 foot level. Levels at 100 feet intervals below main adit. Ore shoot cut on 6th, 7th, 8th, and 9th levels. Stoped above the 8th level, but virgin ground below. On the 7th level, the vein was 16 feet wide, and on the 8th level, 30 feet wide, and said to have averaged $12 per ton in gold. Quartz is very pure, containing some tellurides, and sulphides of copper.

The property was operated continuously from 1904 to October, 1919, shipping all ore to the Mammoth Copper Company at Kennett, who used it for flux in smelting copper ores.

Equipment: Electric hoist, double drum for two compartment shaft; three 50-h.p. motors driving 3 pair Ingersoll-Rand compressors, total capacity 1200 cu. ft. of air per minute; complete machine and blacksmith shop, cars and tools; and aerial tramway, 4400 feet long to bunkers at railroad on west side of Sacramento River.

Six men are employed, repairing bunkers at the mine, and getting equipment in shape to resume operations. Have contract to furnish Shasta Zinc and Copper Company's smelter at Bully Hill with flux.

Owner: Reid Mining Company. Harvey Sallee, president and manager.

Sybel Mine. (*Accident.*) It is situated five miles northwest of French Gulch, in section 7, T. 33 N., R. 7 W., in the French Gulch Mining District, on ridge between the North and South Forks of French Gulch.

Holdings consist of four patented claims which includes millsite; totaling 80 acres. The property is owned by the Shasta Hills Mining Company, of San Francisco. Under lease and bond to Harry Thompson and associates of San Francisco, who also control the Niagara group of mines, having under control 56 claims, and 520 acres of timber.

Operations were started on the Sybel mine in September, 1921, and the property has been under continuous operation to date. It lies at the north edge of the complex of dikes which marks the position of the group of mines near the head of French Gulch. Soda-granite porphyry similar to that of the Franklin, and diorite porphyry cut the slate. The ore for the most part lies in the diorite porphyry near contact of the slate, but in places the workings follow the contact itself, which here strikes about N. 80° W., and dips about 50° north. The ore consists of blue-gray quartz with patches and streaks of white calcite. The quartz has a mottled gray color, but the calcite is milky white and cut by veinlets of quartz and arsenopyrite. The metallic minerals are pyrite, galena, sphalerite, and arsenopyrite. Gold, wherever in plates large enough to be visible, is as a rule close to the small patches of galena. The galena and sphalerite in the quartz indicates the occurrence of rich ore. The ore being stoped carries values from $10 to $200 per ton, and the average mill feed runs about $40 per ton.

Development: At an elevation of 3700 feet, a tunnel has been driven S. 75° E., 700 feet, and a winze has been sunk on the vein from this level to a depth of 150 feet; at 80 feet below adit tunnel, a drift has been run from the winze on the vein 175 feet east, and 175 feet west, developing a shoot of ore 350 feet in length. The vein varies from 12 inches to 4 feet in width. The adit tunnel is 400 feet below the outcrop of the vein. The adit tunnel cut a fault which strikes N. 50° W., and dips north 50°. The present workings on the tunnel level and in the winze are confined to the vein east of this fault, while old workings above this tunnel level were to the west of the fault. The vein strikes N. 80° W., and dips 50° north.

Mine equipment: Laidlaw-Dunn-Gordon 12″ x 12″ compressor, driven by 50-h.p. motor; air drills, blacksmith shop, and cars. There is a new 5-stamp mill on the property, 1000-pound stamps, and one vanner, driven by electric power. Electric power is furnished by Pacific Gas and Electric Company.

The monthly production is about $6,000 to $8,000.

Fifteen men are employed. Harry Thompson, general manager.

Bibliography: U. S. Geol. Survey Bull. 540, pages 68, 69. State Mineralogist Report XIV, p. 777.

West End Mine. It is situated one mile southeast of Whiskeytown, in section 16, T. 32 N., R. 6 W., in the Stella Mining District.

Property consists of West End Quartz mine and one-quarter section of patented land; totaling 180 acres. Owners: Dr. E. P. Mitchell of Winters, John Kesler of Anderson, and Western Star Lodge of Masons of Shasta. Under option to C. D. Jones & Company of Santa Barbara, California.

Two quartz veins occur in the alaskite-porphyry; the West End vein strikes N. 50° W., dips 70° east, the Spanish vein strikes N. 27° E., and dips 80° west. These two veins evidently intersect about 90 feet south of the shaft. The veins vary in width from a few inches up to 2 feet. The ore is white quartz, showing free gold and some iron pyrite. On the 100-foot level, especially near the veins, the rock is much sheared. The alaskite-porphyry adjacent to the veins is in places partly silicified; and elsewhere near the veins is chloritized; in both situations a small amount of pyrite has been introduced. The zone of intense alteration of the porphyry is confined to the close proximity of the veins, and the silicified and chloritized porphyry carries no gold. In the siliceous phase, the alteration consists in the introduction of quartz along narrow and closely spaced fissures.

The development work has been confined to the West End and Spanish veins on the 50 and 100-foot levels, north of the shaft. Developments: Vertical shaft 100 feet deep. At 31 feet below the collar of the shaft, a drift was driven N. 19° E., and cut the West End vein, 110 feet from the portal, then continued 35 feet N. 16° E., and drifted on the vein N. 15° W., 180 feet, where the vein was cut off by a fault, which strikes N. 70° W., and dips 50° north. About 40 feet from where the vein was cut on this level, a crosscut was driven 100 feet N. 45° E., where it cut the Spanish vein, and this vein was drifted on 50 feet north and 55 feet south. On the 100-foot level, the West End vein was drifted on 200 feet north, to where the vein was cut off by the fault striking N. 70° W. A pump was installed by the present company and the mine unwatered. At 130 feet north of the shaft, a crosscut has been driven 80 feet N. 80° E., where the Spanish vein was cut, and a raise is being run on this vein in hopes of picking up the ore shoot developed in the Spanish stope, which has been stoped out for a distance of 60 feet along the vein from the drain tunnel level to the surface.

Equipment: 9-h.p. Hercules gasoline engine driving 6″ Mast-Foss rod pump; 30-h.p. boiler and steam hoist.

Four men employed. R. S. Williams, superintendent.

Reference: State Mineralogist Report XII, page 260; XIII, page 368.

ZINC AND COPPER.

Bully Hill Mines. These properties are situated 1½ miles north of Copper City, in sections 15, 16, 21, 28, T. 34 N., R. 3 W., in the Pittsburg Mining District. Owned by Shasta Zinc and Copper Company, 1800 Hobart Building, San Francisco. D. C. Jackling, president; M. W. Enrich, secretary; G. T. Jackson, general manager.

At Bully Hill, which is on the East copper belt of Shasta County, there are two lodes that have been worked; the Eastern or Delamar lode in the Bully Hill mine, and the Western or Anchor lode in the Rising Star mine. The general course of the Delamar lode is about N. 10° E., and dip approximately vertical. This lode can be traced for one-half mile, the width being from a few feet to 20 feet. The shear zone is more or less distinct throughout and contains irregularly lenticular and overlapping ore bodies. They vary in extent and size from lenticular or sheet-like nodules, a few inches wide, up to bodies 100 feet in length, and 12 to 30 feet thick. The greatest extent of the ore bodies appears to be in a nearly vertical direction, pitching steeply to the north.

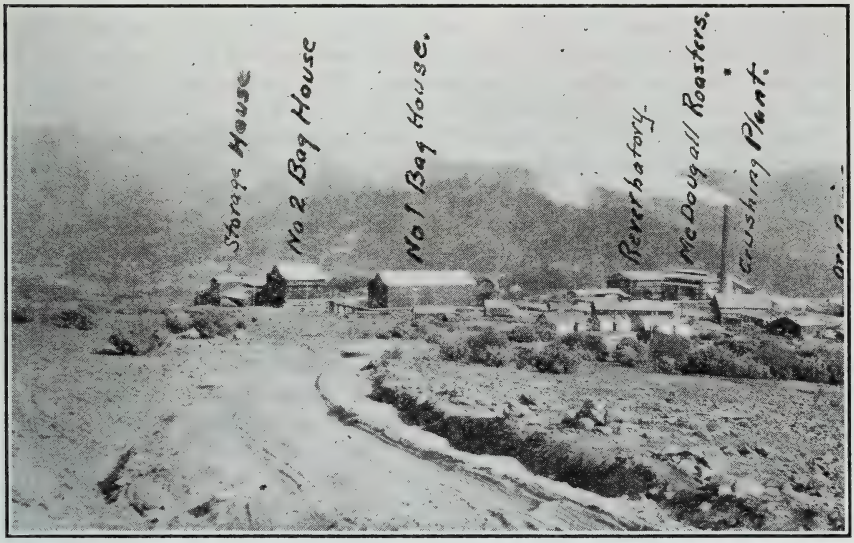
The ore is composed of pyrite, chalcopyrite, chalcocite, bornite, sphalerite, and galena in varying proportions. The Anchor lode is approximately paralled with the Delamar lode, and lies over 200 yards to the west.

It has been developed by tunnel and shaft on the Rising Star mine. Here the ore bodies are irregularly distributed in a shear zone in the rhyolite and form a series of lenticular and overlapping ore bodies. The ore is principally sphalerite with some pyrite, and chalcopyrite.

The quartz is scarce in the gangue, and barite is more common, particularly in ore that is rich in copper. The average content of the ore in these workings is about 22% zinc, 2% copper, 2 ounces silver and 60 cents in gold.

Since 1917, all development work has been confined to the Rising Star mine. A series of lenticular ore bodies have been opened up on the 5th, 6th, 7th, 8th, and 9th, levels of this mine.

Developments: The Bully Hill mine has been opened by a number of tunnels with extensive drifts, crosscuts, and raises, comprising several thousand feet. There are nine levels, 100 feet apart, eight raises from 50 to 560 feet in height, and an 1100-foot crosscut tunnel on the Bully Hill claim, about 600 feet below the gossan outcrop (No. 3 level). At 1100 feet from the portal of the tunnel where the vein was cut, a shaft (3-compartment) was sunk to a depth of 950 feet. No. 3 level is connected by chutes and raises with the upper workings, of which some of the drifts run along the vein 800 to 1000 feet.



Zinc Oxide Plant, Shasta Zinc and Copper Company, Winthrop, Shasta County.

Rising Star Mine. There is a three-compartment shaft, 800 feet deep. The main adit tunnel (No. 5 level) intersects the shaft 218 feet below the collar with six levels below No. 5 level, 100 feet apart, with drifts on the 6th, 7th, 8th, and 9th levels. Ore is trammed through No. 5 level to storage bins, then hauled in cars by horses one-half mile to bins at the smelter at Winthrop.

Mine equipment: Two-reel electric hoist, 10-drill Rand compressor, driven by 60-h.p. motor, blacksmith shop, and timber-framing shop. Mine water is handled by two 5″ x 9″ Aldrich quinplex pumps, each driven by 100-h.p motor; one pump on the 9th level, the other on the 11th level.

Smelter: During the past two years, there has been constructed on the property a zinc oxide plant, having a capacity of 150 tons per day.

This plant was put in operation during the early part of June, 1922. The method of treating the ore from the Rising Star mine, which runs 22 per cent zinc, 2 per cent copper, 2 ounces silver, and about 60 cents in gold, consists in charging a mixture of fine roasted ore and coal dust into a copper reverberatory smelter. The heating of the mixture to the temperature of the reverberatory furnace will reduce the zinc oxide to zinc and volatilize it. The volatilized zinc will oxidize in the furnace gases and pass with them to be recovered in the flues.

The residual ore mixture is smelted in the usual way for recovery of copper matte with gold and silver values.

Description of plant: From the crude ore bins, a belt conveyor carries the ore to a 10″ x 20″ Blake crusher, where it is reduced to 2″ size. A 20″ belt feeder draws the ore from small surge hoppers and discharges into a 37½″ x 15″ set of rolls, where it is reduced to ⅝″ size. The discharge from the rolls is conveyed by a 16″ bucket elevator to a Mitchell electric vibrating screen, the oversize going to a second set of rolls, and being returned to the elevator. The screen undersize is automatically sampled and delivered to a conveyor which is equipped with a weightometer. The undersized ore is finally conveyed to any one of the eight storage bins, of a set of 16 bins, set back to back, each having a capacity of 2200 cubic feet. The remaining 8 bins are used for the furnace charge, consisting of calcines, flux, and coal. Under each fine ore bin is a belt feeder, which permits a predetermined flow to conveyors, leading to the McDougall roasters. The roasted ore is discharged to steel-flight conveyors, and conveyed back to the opposite side of storage bins, cooling en route. The calcines are stored in 5 bins, the remaining three being used for coal and flux. The furnace charge is made up by belt feeders, which deliver to a conveyor. A bucket elevator elevates and assists in mixing the charge before it goes to the hoppers of the reverberatory furnace. The reverberatory furnace is fired by fuel oil. The slag is handled in 5-ton hand operated pots and hauled to the dump by electric locomotives. The matte is handled in matte cars, and hauled to bins, after cooling, where it is loaded in railroad cars for shipment.

The waste gases are drawn into cooling flues. Exhaust fans are used to draw the gases through the flue system. All gases are filtered through bags. Bag house No. 1 is a steel structure containing four fireproof compartments, each compartment having four transverse hoppers, which connect with 88 bags. The bags are 18″ diameter and 25 feet long. A mechanical shaking apparatus is used. From No. 1 bag house, the zinc oxide, which contains 3% soluble sulphates, and is not the grade required, is loaded in cars from the hoppers and trammed to the refining plant. These cars are hauled up an incline and dumped into hoppers over refining furnace, which has a capacity of 30 tons per day. Here the crude zinc oxide is reheated, at a temperature of 1200°. The gases from this furnace are drawn through flue (trail) to No. 2 bag house, containing 500 bags, 18″ diameter by 25 feet long. The zinc oxide is here collected in canvas sacks, 4 feet long by 20 inches in diameter, which are attached to hoppers below the bags. These bags are then transported to the storage building, which is of steel construction throughout, 92 feet by 141 feet. This storage building contains a number of bins in which the zinc oxide can be distributed according to analysis. The capacity of the bins is one month's run. A bolting machine, mixer, and two packing machines complete the equipment in the storage house. Here the zinc oxide is packed in barrels, which are paper lined and ready for shipment to the market.

The plant has been under steady operation since June 15, 1922, production being 30 tons of zinc oxide per day, with 15 to 20 tons of copper matte.

Sixty men are employed at the mine, and approximately 140 men around the smelter.

Bibliography: State Mining Bureau Bulletin No. 50, State Mineralogist Reports, XIII and XIV, U. S. Geol. Survey Redding Folio.

SILVER.

Chicago Consolidated and Silver Falls Mines. Owner, Dr. F. M. Archer, of Redding. Situated in South Fork Mining District, 2½ miles northwest of Igo. It is under option to the California Bi-Metallic Company of Santa Barbara, California. L. G. Vinson, president; Paul Drinkwitz, secretary; L. M. Barker, general manager. Eight men are employed.

Bibliography: State Mineralogist Report XVIII, pp. 316, 317.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

The report of activities in the Auburn field division has been omitted from the current chapter on account of the disruption of field and office routine due to the presence of Mr. Logan at the Argonaut Mine while rescue work was in progress. All other available time was devoted to actual field work which will be reported later.

SAN FRANCISCO FIELD DIVISION.

E. S. BOALICH, Chief Mining Engineer.

Mono County.

In August of this year Mono County was visited for the purpose of ascertaining the condition of the mining industry in that region and obtaining up-to-date information regarding development and mine operations which have taken place since the last report on that county by the State Mineralogist, in 1920.

This portion of the state is exceedingly interesting from a geological standpoint. However, it has been described in detail so often that it is not considered advisable to repeat those descriptions here. References have been added at the close of each paragraph of the principal publications that contain data of both scientific and economic interest concerning the county. These bulletins and reports will be found available for reference in the offices of the State Mining Bureau and also in many libraries throughout the United States.

The greater part of Mono County consists of a table land having an elevation of from 5000 to 7000 feet above sea level, which is traversed by a series of north and south mountain ranges rising several thousand feet above the plateau. Its western border includes portions of the Sierra Nevada Mountains, which are often as high as 13,000 feet above the sea.

Surrounded by lofty peaks lies Mono Lake, a body of water with no outlet, which has an approximate area of 1100 square miles, and whose surface has an elevation of 6426 feet. The waters of this lake are heavily charged with various salts of sodium and potassium.

Mining and stock raising are the principal industries. The county suffers on account of poor transportation facilities. The only railroad is the Nevada-California narrow gauge line, which cuts the southeast corner, but which is of little benefit to any of the mining districts except Benton and vicinity.

Stage lines from Nevada points serve most of this territory.

Mining in this portion of the state is largely confined to the production of gold ore, and the industry is showing distinct signs of emerging from the lethargy that has been evidenced during recent years. Prospecting and development of properties on a small scale was noted throughout the county, and in addition several of the larger mine owners are perfecting plans for the resumption of activities which point toward more prosperous days for the entire community.

Mono is a large county, and as previously intimated, comparatively difficult to traverse, even with the modern automobile. Sand and volcanic ash in some sections make the roads extremely heavy, and differences of 3000 or 4000 feet in elevation within short distances are of common occurrence. The mining districts are quite isolated from each other, even when separated by only a few miles as the crow flies. Instead of discussing the various properties in alphabetical order, it is therefore deemed more appropriate to take up one district after another, geographically, in the following paragraphs.

ANTELOPE VALLEY, OR WEST WALKER RIVER, DISTRICT.

Gold, silver, copper, lead, zinc, cadmium, and iron ores, and barite, marble, and building stone occur in this district, which lies principally in Ts. 8 and 9 N., R. 23 E., and is the most northerly part of the county in which any mining has been done.

The only mine which has been active during recent months is the *Golden Gate*, situated near Coleville, and operated by Messrs. Brown and Donovan. The ten-stamp mill has been run intermittently since last winter and possibilities of steady production are said to be particularly bright at the present time.

See State Mineralogist Report XV, pp. 138–141, 165.

PATTERSON DISTRICT.

This district includes approximately eighteen square miles lying five miles west of the town of Sweetwater, Nevada, on the eastern slope of Mount Patterson. Mining has been quite dormant here, but the famous

Silverado property has recently been acquired by the *Mono Mines Co.* of Nevada and ambitious plans are being outlined for work which is to be inaugurated without delay. The mine lies in Sec. 19, T. 7 N., R. 25 E. Values are principally in the form of silver chloride, with small amounts of gold, in a vein varying in width from 2 feet to 5 feet, which has been opened by adits on three levels.

Nels Buck, 3123 N. Clark Street, Chicago, Ill., is president of the present company, and A. G. Anderson, Sweetwater, Nevada, is vice president and manager.

The corporation is said to have purchased the old Bodie power plant on Green Creek, south of Bridgeport, and will construct a power line, a distance of about twenty-five miles, to the mine.

A snow slide in February, 1922, wiped out the camp that was used as mine headquarters. The old mill was not destroyed, but the present program calls for the construction of a new and enlarged mill, as well as a permanent camp, at a point lower down the canyon where a similar disaster could not occur.

In addition to the eight claims previously held in the Silverado group, title has been acquired to the *Kentuck* property adjoining.

State Mineralogist Report VIII, p. 361; XV, p. 165.

MASONIC DISTRICT.

Masonic lies about two miles from the California-Nevada line and twelve miles northeast of Bridgeport, in T. 6 N., R. 26 E., at an elevation of 8000 feet. The surrounding country rock is practically all basic lava, although the principal ore deposits so far discovered are associated with silicified zones in an area of intrusive granite.

The camp of Masonic, proper, is quiet. The principal work being done there is that of Messrs. Bray & Frazier, of Reno, who leased the *Pittsburg-Liberty Mine* in the Spring of 1922. F. W. and Geo. C. Stall, owners of the *Serita* property, are reported to be preparing to resume operations in the near future.

In contrast to the older portion of this district, the neighborhood of the *Chemung Mine* (*Masonic Mines Association*) about 2½ miles southeast of the town of Masonic, presents a scene of real activity.

The Chemung, which is only one claim of a large group owned by the Masonic Mines Association, has produced some phenomenally rich gold ore. It has had a checkered career, however, due to litigation and conflicts between the various interests identified with its development. The Mining Bureau is in no way interested in the history of the troubles which have involved the owners, leasers, and subleasers of this property, but it is encouraging to record the reported fact that a readjustment has been effected and that a new and united regime, headed by Mr. J. Sub Johnson* of Visalia, California, will soon take charge, and that plans for systematic development of the mine and the construction of a mill have already passed the preliminary stages.

---

*The Bureau has been advised by Mr. Johnson under date of September 18th, as follows: The new company will be known as the *Visalia Masonic Mining Company*, president, George C. Cobb; vice president, Frank Carson; secretary, Bertha H. Haas; treasurer, L. C. Hyde, and manager, Wm. Dexheimer. We expect to have the quartz mill in operation within the next fifteen days and will be nicely equipped for the winter's run.

The greatest depth reached in the mine to date is 185′, vertical. Large quantities of medium grade ore have been developed and several shipments of high grade running into values of several hundred dollars per ton have been made, but transportation costs are well nigh prohibitive.

It is planned to construct a five-stamp mill, and to regrind in a Denver quartz mill. Some of the machinery for the plant is already on the ground.

On claims adjoining the Chemung, the Masonic Mines Association has recently let the following leases. Early in August prospecting work on each lease was just getting under way.

Burgess and Cummings Lease, on the Golconda No. 1 Claim. A 4 x 7 shaft was down about 25′ and a 5′ vein was exposed that has shown values averaging $12.50 per ton in gold.

P. J. Hotze Lease, on north end of the Pennsylvania Claim.

A. B. Smith Leasing Co., on south end of the Pennsylvania Claim. A 4 x 8½ double compartment shaft had reached a depth of about 25′.

In addition to the above, considerable work is being done by other parties in the same portion of the Masonic district.

Among them may be mentioned:

Success Mine, one mile south of the Chemung, C. C. Hayes and J. H. Hayes, Bridgeport, owners. This property consists of two claims which have been developed by a 50′ shaft. Unfortunately water was struck in sufficient quantities to stop work with a windlass and it now stands at the 25′ level. At that point a 3′ vein was noted which is said to carry average values of $11 in gold. Grab samples have shown exceptionally high values in both gold and silver.

This vein strikes northeast and southwest and dips to the east. Outcroppings, heavily iron stained, cover a large area in the vicinity of the shaft and from what can be seen, it is difficult to decide whether the main ore body has been discovered or not. The country rock is andesite.

Faudre and Welsh Group, C. L. Faudre and Frank Welsh, Masonic P. O., owners. This group of ten claims is located at what is locally known as Camp Eleanor, one-half mile south of the Success property, on the new road from Bridgeport to Masonic, via the Chemung Mine.

The country is highly mineralized, but only small stringers have been discovered as yet. An 80-foot crosscut adit has been driven which cuts four small veins, all of which panned well.

Brownie Group, W. L. E. Brown, Masonic, owner. Three claims, which comprise this group, have been located along the strike of a N.E.-S.W. vein, which has been traced for about 1500′ on the surface at Camp Eleanor. Several samples taken along the outcrop averaged $8 in gold. One sample was taken across 6 feet of good looking vein material.

The ore makes on a contact between schist and granite. Mr. Brown also owns a water right on a good spring adjoining his mining claims. He has recently located two claims which constitute the South Extension of the Masonic Mines Association property and has prospected them in a small way by open cuts.

See State Mineralogist Report XV, pp 143, 160; XVII, p. 153.

BRIDGEPORT DISTRICT.

For want of a better description, this name is used to cover the area including the travertine deposit one mile southeast of Bridegport, and the mines in the vicinity of Green Creek, in T. 3 N., R. 25 E., eight or ten miles south of that town.

The travertine has not been worked for years, until 1921, when a small shipment was made by the Dinneen Marble Company of Oakland. Some beautiful stone has been produced here. The gold mines near Green Creek, notably Dunderberg & Ward, have been idle for many years, although valuable ore is said to have been mined at both places and both were once equipped with mills.

BODIE DISTRICT.

Bodie, one of the most famous old mining camps of the west (situated 16 miles southeast of Masonic), remains quiescent, as it has been for the past several years.

Leasers are working in a small way in the *Standard Mine*, owned by J. S. Cain, and occasional mill runs are made in the mill of that property, which is in excellent condition.

A surface discovery on the site of the old *Goodshaw Mine* was made about August 1st, which aroused considerable interest among the few remaining inhabitants of the town. A small amount of work at a point where no outcroppings were in evidence, at all, revealed quartz which panned very rich in gold. Additional work might easily open up something that would help revive interest in this district which has a production record of $25,000,000 to $30,000,000 since its discovery in 1860.

Immense mine dumps, said to average as high as $5 in gold per ton, will some day undoubtedly be cyanided or otherwise treated at Bodie, even if no new ore bodies of any extent are brought to light.

See State Mineralogist Report XV, pp. 143–149, and numberless other official and technical publications issued during the past fifty years.

LUNDY AND MONO LAKE DISTRICT.

This region is extremely interesting. Within a radius of a few miles are found granite, basic lavas, recent volcanics, rocks of the metamorphic series, glacial drift, and lake deposits.

The granite, which contains a number of gold-bearing quartz veins, varies from coarse-grained, light-colored to fine-grained, dark-colored granodiorite. It is frequently intruded by dikes.

The metamorphic series, including hard bedded limestone, and quartzite has in places been found to be gold bearing.

The recent volcanics contain all varieties from fine pumice sand to glassy and porous rocks which may sometime be used for structural purposes.

The waters of Mono Lake contain about 5 per cent of solids, principally sodium chlorides, carbonate and sulphate. These salts have been intermittently produced in a small way at various times in the past by crude evaporating methods.

It is said that traces of gold are also present, in solution, in the lake waters. When this locality was visited three plants were found on the lake where efforts are to be made to extract gold from the water on a commercial scale.

While the above objective is more or less widely advertised, the exact processes to be used are kept veiled from public view. It is understood that the recovery of the gold is to be attempted by electrolytic methods.

The plants, which are all on the northwest shore of the lake (near the post office of Mono Lake) are said to be under the following management:

Mono Recovery Company, W. M. McDowell, Tacoma, Wash., president; P. F. Gleason, secretary and treasurer.

Professor Parker's Plant, D. G. Kidder, manager.

Whittaker Plant, W. Harrison Whittaker, manager.

As far as could be discovered, no attempts at actual operation have yet been undertaken in any of the above, although installation of electrical equipment was in progress by the Mono Recovery Company.

It has been a rather widely accepted opinion among technical men that endeavors of this kind are foredoomed to failure so it will be interesting to follow the activities of the above, and mark the degree of success they may attain.

Mining in the Mono Lake region is inactive. The *Crystal Lake* property at Lundy remains idle, although it is reported that the owner, Mr. Thos. R. Hanna, of Martinez, California, contemplates reopening the mine at an early date.

See State Mineralogist Report XV, p. 167.

BENTON DISTRICT.

Benton, the oldest mining town in Mono County, is situated in the southeast portion, 24 miles north of the Inyo County line and 7 miles west of the Nevada State line. Blind Spring Hill rising immediately east of the town is the center of most of the mining activity which has taken place in the district.

Report XVII of the State Mineralogist (p. 151) contains mention of the activities that were observed in this region in 1920.

In August, 1922, a period of depression was being passed through and practically nothing was being accomplished. Some development at the *Comanche Mine* and a similar small amount by the *Diana Development Company* was all that prevented the hill from being entirely deserted.

See State Mineralogist Report VIII, p. 376.

CASA DIABLO DISTRICT.

The *Casa Diablo Mine,* the principal property in this section of Mono County, is twenty-two miles north and a little west of Bishop, Inyo County. This mine, which was discovered in 1895 and which has been idle for some time, was recently taken over by the *Bishop Community Gold Producers Mining Co.,* H. T. Bonfield, superintendent. Among other well known men who were backing the property is Jas. J. Jeffries of Los Angeles.

In this mine are three veins between granite walls—their width varying from 8 inches to 2½ feet. Average values are said to be $12 per ton. Several thousand feet of development work has been done. Equipment includes an electric generating plant and a ten-stamp mill, together with a saw mill, air compressor, four-mile transmission line, and eight-mile water pipe line.

Seventy-five men were employed in the mine and on the surface.

Napa County.

Napa Asbestos Quarries. Jas. S. Brogan, 28 Hill Street, San Francisco, and R. R. Norton, 2545 Benvenue Avenue, Berkeley, owners.

It is believed that this is the first recorded occurrence of asbestos in Napa County. The deposit, which lies in Sec. 4, T. 7 N., R. 3 W., is said to have been discovered in 1907 or 1908, but it has only recently been brought to the attention of the Mining Bureau.

Messrs. Brogan and Norton have located nineteen claims in the above township, which lie about one mile west of the Napa-Berryessa road, and one-half mile north of the old Perch Ranch, eighteen miles northeast of the town of Napa.

Short fibre chrysotile asbestos is disseminated throughout a body of serpentine which outcrops prominently for a length of at least fifteen hundred feet and a width of three hundred feet. Erosion has exposed the ore on the west side for a vertical distance of approximately two hundred feet. The general strike of the lens of serpentine, which is surrounded by Cretaceous shales, is N.W.-S.E.

Aside from the surface evidence to be noted, the deposit has been prospected by an adit driven from the east side of the hill at a point about two hundred feet lower than the apex of the outcrop. This adit is sixty feet long and at the face has penetrated ore quite similar in character to the surface croppings.

The elevation of the property does not exceed thirteen hundred feet above sea level, and the haul to the railroad (at Napa) is an easy one, over well-kept dirt and gravel roads.

Timber for fuel or other purposes is scarce.

Power would have to be developed by internal combustion engines, as no electric power line is available within a radius of several miles.

Spring water and an excellent camp site are located within one-half mile of the deposit.

A picked sample of the ore taken from the surface was tested in the Bureau's laboratory and found to contain 49 per cent fibre.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Inyo County.

Bishop Creek Milling Co. Property located 22 miles southeast of Laws. Milling operations were suspended February, 1922. At present the company is putting down a number of diamond drill holes and claims to have opened up several large bodies of low grade ore. Fifteen men are employed.

Between July, 1921, and February, 1922, running at reduced capacity, the company shipped approximately 500 tons flotation concentrates, which gave net smelter returns of $73,860. This represented a tonnage of about 12,500 tons of crude ore.

The officers of the company are as follows: Gaylord Wilshire, president; H. R. Kearns, secretary; L. M. Allen, superintendent. An office is maintained at Bishop, California.

California Alkali Co. Located on the west shore of Owens Lake at Cartago, a station on the Owenyo branch of the Southern Pacific Railroad. The company operated its plant from 1917 till May, 1921, when it closed down due to the low price of soda ash, as compared to that received during the war period. The plant has a rated capacity of 100 tons dense soda ash per day. At present plant is idle, though operations may be resumed the early part of the coming year.

Main office of the company at 639 Holbrook Building, San Francisco. T. W. Decker, president; J. F. Shuman, vice president; E. B. Bonestell, secretary-treasurer; W. H. Lowery, superintendent.

Cerro Gordo Mines Co. Mines are located about 5½ miles northeast of Keeler. Company has a 50-ton mineral separation flotation plant at Keeler. This was built in 1921. Ore is brought from mines to mill by means of an aerial tramway, which has a rated capacity of 20 tons per hour. At present the mill is treating a silver-lead ore. Heads average 5 per cent lead and 12 ounces silver. Flotation concentrates run 68 per cent lead and 146 ounces silver. Mill is run on two shifts only. Twenty-five men employed at mine and mill. F. J. Hambly, president; C. A. Stockton, superintendent. Main office, San Jose, California.

Chemical Refining Co. Located 2 miles south of Keeler on east shore of Owens Lake. At present, plant is idle. Manufactures borax and potash from brine. When running has a capacity of 10 tons borax per day, and employs 15 to 20 men.

Main office: Hibernia Bank Building, San Francisco. E. J. Tobin, president; E. T. Royce, chemist.

Darwin Silver Co. Mines and mill are located in the Darwin Mining District, 24 miles southeast of Keeler. At present, the property is under lease to Mr. A. G. Kirby, former manager of the company. About 80 tons per day are being treated at the plant. 50 per cent is dump ore and 50 per cent comes from the Lucky Jim Mine. The heads average 8 per cent lead and 10 ounces silver per ton, making a concentrate running 40 per cent lead and 70 ounces silver. Sixty-three men employed at present.

The company had planned a very comprehensive system of developing its various mines. The ores from these were to be treated at one central plant of 300 tons capacity. Unfortunately, owing to financial troubles of the largest stockholder of the company, these plans for the present remain uncompleted. A. G. Kirby, lessee. Office, Darwin, Inyo County, California.

Reference: State Mineralogist Report XVII, pp. 289, 290.

Estelle Mining Co. Mines located 5 miles east of Keeler, on the west slope of Cerro Gordo Mountains.

Company owns 29 mineral claims containing veins of lead-silver ore. At present shipping about 100 tons a month from its Morning Star claim. Shipping ore averages 6 per cent lead, 55 ounces silver and .4 ounce gold per ton.

Property described in detail in Report XVII State Mineralogist.

R. C. Troeger, president and general manager; A. Ramish, treasurer; A. H. McAdoo, secretary. Office: 803 H. W. Hellman Building, Los Angeles.

Inyo Development Co. Plant about one mile northwest of Keeler on east shore of Owens Lake. The plant has a capacity of 20 tons soda ash per day. The company also shipped about 25 tons per day of pulverized crude 'Trona.' About 40 men employed at present.

Main office at 639 Holbrook Building, San Francisco. T. W. Decker, president; J. S. Hunter, superintendent.

Inyo Talc Co. Mines located 17 miles southeast of Keeler. The deposit occurs in a crushed zone of impure limestone. The vein averages 20 feet wide, and the ore body is developed for 240 feet in length. In the last 3½ years at least 30,000 tons of talc has been mined. A grinding plant of 30 tons capacity is located at Keeler. The ground talc is used for talcum powder, as a body for fancy soaps, and as a filler by the paper mills. A considerable business has also been developed in the use of talc by the electrical appliance industries. About 30 men employed.

Franklin Booth, president; W. A. Read, superintendent. Office: Equitable Bank Building, Los Angeles.

Leroy Mine. This was formerly known as the Old Daisy Mine and is located 24 miles southeast of Big Pine. Consists of 4 claims of lead-silver-gold bearing veins. Shipments sent to the Garfield smelter gave returns of 52 per cent lead, 32 ounces silver, and .8 ounce gold.

Property is owned and being developed by F. M. and D. T. Bedell.

Natural Soda Products Company. Plant situated two miles south of Keeler on east shore of Owens Lake. This is the largest of the chemical plants on Owens Lake, and manufactures bicarbonate of soda, as well as soda ash. Plant fully described in Report XVII of the State Mineralogist.

Employs about 150 men. Main office: Bishop, California. W. W. Waterson, president; Paul Waterson, superintendent.

Opal Mine. Property 26 miles southeast of Big Pine. Owned by Bedell Bros. Silver-lead. At present idle.

Imperial County.

California Gypsum Corporation. This company has gypsum deposits in the western part of Imperial County, near the San Diego line. It has asked permission of the Corporation Commission to sell $400,000 of its stock, so as to be able to install a transportation system consisting of a narrow gauge railway and in part an aerial tramway; also the first unit of a gypsum plant of approximately 500 tons capacity.

Los Angeles County.

Lost Treasure Mine. This property is situated six miles southwest of Azusa, in the San Gabriel Canyon. In consists of four claims: Lost Treasure No. 1 and No. 2 and Lazy Boy No. 1 and No. 2. A small open cut on the croppings is reported to have assayed 50 ounces silver from a six-inch streak. Fifty feet below this open cut a tunnel has been run on this same streak and the owners report this to have given values of 30 ounces silver per ton.

The property is owned by Messrs. Holcomb, Barber and Fairs, of Azusa, California.

About 20 years ago, an English company operated a silver mine on the opposite side of the canyon from the Lost Treasure Mine, known as the Victoria Mine. This had a small reduction plant to treat the ores at the mine.

Another company also operated the Kelsey Mine near the Victoria about the same time. This company also had a small treatment plant on the premises. As stated before, however, these properties have been idle now for the last twenty years.

Sunshine Mines. Messrs. Christman, Fuller and Meuer have located 10 claims, in Boquet Canyon, 17 miles from Saugus. These claims were abandoned about 10 years. The above named gentlemen relocated these several months ago and have been developing them since. They claim to have a quartz vein averaging 25 feet in width, which at a depth of 15 feet gave assay returns of $6.20 per ton, and at 50 feet in depth assayed $10.30 gold and 3.10 ounces silver. The closeness of this property to Los Angeles, being only 53 miles distant, will make mining men watch its development with much interest.

San Bernardino County.

California Rand Silver, Incorporated: This company paid a two cents per share regular dividend for the month of August, totaling $25,600 and an extra dividend of ten cents per share, totaling $128,000, or a total of $153,600. With this distribution, the total dividend of the mine since January 1st of this year is 68 cents per share, or $870,400, and the grand total of mine dividends to date is $1.51½ per share, representing a distribution of $1,939,200.

Below is an extract from the August report of this company, as sent to its stockholders:

"Ore Extraction and Advancement.

During August, tonnage extracted was as follows:

Shipping ore	989 tons
Milling ore	4749 tons
Waste	3329 tons
Total extraction	9067 tons

Advancements made were as follows:

Drifts	1030 feet
Crosscuts	258 feet
Raises	219 feet
Shafts	87 feet
Ore pockets	50 feet
Water sump	7 feet
Stations	50 feet
Total feet of advancement	1701 feet

Milling Operations.

A continuance of the satisfactory showing of the mill noted in last month's report is gained from the following figures for August:

Total ore milled	4649 tons
Daily average, 31 days	150 tons
Daily average, running time	160 tons
Running time	29 days 2 hours
Lost time	1 day 22 hours
Average gold heads	$1.96
Average silver heads	16.095
Total average value	18.055
Average gold tails	.39
Average silver tails	1.13
Total average value	1.52
Average gold extraction	80%
Average silver extraction	92.98%
Total average extraction	91.58%
Recovery per ton	$16.535
Total recovery on 4649 tons	76,871.21
Average concentrate value	346.51
Tons of concentrates produced at $346.51	222 tons
Cars of concentrates shipped	203 tons net

Betterments.

Plans for betterment along several important lines will soon be realized.

The long delayed mill machinery (which had to be built to order) has arrived and its installation will be but a matter of days. With said machinery in place, the capacity of the mill will have been increased from 140 or 150 tons per day to 200 tons per day.

The difficult and tedious laying of a pipe line over the gap in Red Mountain to our new water wells at Teagle Springs is nearly completed and we will shortly have a supply of 30,000 gallons of good mountain water in addition to our contracted supply from the Yellow Aster.

The machinery for the auxiliary hoist of Shaft No. 2 is on the ground and the work of installation is now in progress. The hoist will be located on our 12th level at a depth of 770 feet, and the new machinery will be utilized in connection with the sinking of the shaft to a depth of 1000 feet or more. This development is to be prosecuted to ascertain what values lie below the so-called water zone.

Uranium Seven and Ten.

The Coyote Company, which jumped our Uranium Claims, Seven and Ten, has as yet made no move to enforce its demand that we cease working on these properties. Good ore bodies have been developed on both of these claims and your present Board of Directors is convinced that it will be able to hold the ground for the Company as against any adverse contention. Our attorneys and engineers advise us that our rights to this property are unquestionable, and the only danger to the Company lies in a possible failure to vigorously defend those rights when they are assailed. In this connection your attention is again directed to the importance of electing a board of directors at the annual meeting on September 14th whose policy will be to protect, in all legal ways, the Company's rights to this ground.

Financial.

Receipts from the smelter for August (with strike conditions preventing shipments for eleven days of the month) were $150,596.18. After the payment of this dividend of $153,600, the company has cash on hand in the sum of $319,062.84."

Gold Mountain Mine. This property at Doble, north of Baldwin Lake, which for the past two years has been operated by James Hulmes, has recently been sold to a group of Arizona mining men.

The property was opened up over 30 years ago by 'Lucky' Baldwin and Bud Doble, and at one time was owned by Capt. J. D. de Lamar. It is equipped with a 40-stamp mill and has a capacity of 120 tons per day. The ore is low grade, about $4.00 gold per ton, and it is said there are very large bodies of this value still available.

South Rand Mines Co. This company has recently entered the Randsburg field. Its holdings lie between the Sunshine on the east and the White mines on the west, and comprise 80 acres of patented land, besides one mining claim location. It will develop its veins by shafts and drifts.

E. L. Burton, president; Dr. C. A. Rogers, vice president; I. E. Porter, secretary-treasurer. Office, Bakersfield, Cal.

San Luis Obispo County.

American Canadian Oil Products Co. This company proposes to erect a pilot plant of 100 tons per day capacity to work its oil and tar sands located near Tyber, in the Tyber oilfields. This is to be ready for operation within the next 90 days. It intends to use what is known as the McClave process, developed at Denver, Colo. If the pilot plant proves commercially successful, a large one of 1000 tons capacity is to be erected.

G. W. Stephenson, president. Office, Owl Building, San Diego, Cal.

La Panza Placers: A Mr. Pierce of Gilroy, Cal., has taken a lease on several miles of La Panza Creek. He has developed a dredge which he believes will successfully work these gravel deposits. Two of these dredges are now on the property but due to lack of water, the writer unfortunately could not witness their operation.

Patriquin Quicksilver Mine. This quicksilver property, 6 miles north of Parkfield, is being reopened by Chas. R. Mayhall and associates of San Luis Obispo. The company operates under the name of the Master Quicksilver Mining Company, and will use a new type of furnace called the Master furnace. This furnace will have a capacity of 30 tons per day of crude ore and will not cost when erected but one-fifth as much as a Scott furnace, the most efficient known furnace at present used in the quicksilver industry. The owners claim this furnace is fully as efficient as the Scott and its low cost, both as to initial installation and operation, should make those interested in the quicksilver industry watch actual results obtained from its operation closely.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. COLLOM, State Oil and Gas Supervisor.

From August 12, 1922, to and including September 9, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Paragon Oil Company	17	19	15	15	Coalinga
Salvia Oil Company	24	20	14	19	Coalinga
South Coalinga Oil Company	12	21	14	1	Coalinga
HUMBOLDT COUNTY:					
Humboldt Oil Company	6	2	1	2	-------------------
KERN COUNTY:					
Belridge Oil Company	34	30	24	15	Elk Hills
Pacific Oil Company	35	30	24	106	Elk Hills
Bangor Oil Company	24	28	27	3	Kern River
Gray Heirs	3	29	28	41	Kern River
Associated Oil Company	22	31	23	41	Midway
Caribou Oil Mining Company	28	31	23	6	Midway
Chanslor-Canfield Mid. Oil Co.	26	31	22	24	Midway
Chanslor-Canfield Mid. Oil Co.	26	31	22	25	Midway
Pacific Oil Company	27	31	23	1	Midway
Pacific Oil Company	35	31	23	42	Midway
Pacific Oil Company	1	32	23	104	Midway
Pacific Oil Company	11	32	24	31	Midway
Pacific Oil Company	15	32	24	20	Midway
Calitroleum Oil and Gas Co.	4	11	23	2	Sunset
El Dora Oil Company	6	11	23	1	Sunset
Midway Northern Oil Co.	32	12	23	10	Sunset
LOS ANGELES COUNTY:					
Bona Fide Oil Syndicate	20	4	12	2	Long Beach
Bush, R. R., Company	20	4	12	5	Long Beach
Calmont Oil Company	19	4	12	2	Long Beach
Capital Oil Company	29	4	12	1	Long Beach
Dabney Oil Syndicate	20	4	12	5	Long Beach
Dabney Oil Syndicate	29	4	12	15	Long Beach
Davis-MacMillan Syndicate	30	4	12	1	Long Beach
General Petroleum Corporation	19	3	12	4	Long Beach
Hoekel, S.	19	4	12	1	Long Beach
Hughes Drilling Company	19	4	12	1	Long Beach
Huntington & North. Pet. Co.	30	4	12	1	Long Beach
Jergins, A. T., Tr.	19	4	12	2	Long Beach
Leonard Wells	30	4	12	3	Long Beach
Liberty Oil Syndicate	19	4	12	Harlow 1	Long Beach
Lyceum Oil Syndicate	19	4	12	1	Long Beach
Moore-Tobias	30	4	12	1	Long Beach
Mutual Oil Association	30	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Bauman 1-A	Long Beach
Prouhet & Troupe	30	4	12	1	Long Beach
Rice Ranch Oil Company	19	4	12	Kelly-Garner 1	Long Beach
Shell Co. of California	19	4	12	2	Long Beach
Shell Co. of California	29	4	12	1	Long Beach
Shell Co. of California	29	4	12	2	Long Beach
Union Oil Co. of California	30	4	12	L. B. Com. 6	Long Beach
United Oil Company	29	4	12	5	Long Beach
Western Star Oil Company	19	4	12	Gray 1	Long Beach
Windemere Oil Company	19	4	12	1	Long Beach
Amalgamated Oil Company	8	4	14	1	Redondo
Fullerton Oil Company	8	4	14	Lenz 1	Redondo
Chanslor-Canfield Mid. Oil Co.	8	4	14	Del Amo 1	Redondo
Chanslor-Canfield Mid. Oil Co.	15	4	14	Torrance 3	Redondo
Shell Co. of California	8	4	14	1	Redondo
Western Star Oil Company	8	4	14	1	Redondo
B. G. T. Oil Company	5	3	11	1-A	Santa Fe Springs
General Petroleum Corp.	5	3	11	60	Santa Fe Springs
General Petroleum Corp.	5	3	11	61	Santa Fe Springs
General Petroleum Corp.	6	3	11	2	Santa Fe Springs
Jameson Petroleum Company	6	3	11	3	Santa Fe Springs
Jameson Petroleum Company	6	3	11	4	Santa Fe Springs
Kirkpatrick Bros.	6	3	11	1	Santa Fe Springs
Petroleum Midway Co., Ltd.	5	3	11	Pierce-Crawford 1	Santa Fe Springs
Petroleum Midway Co., Ltd.	5	3	11	Spencer 1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Baldwin 1	Santa Fe Springs

Company	Sec.	Twp.	Range	Well No.	Field
Petroleum Midway Co., Ltd.	6	3	11	Mattern 2-1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Steinly 1	Santa Fe Springs
Santa Fe Springs Syndicate	6	3	11	2	Santa Fe Springs
Shell Co. of California	6	3	11	1	Santa Fe Springs
Standard Oil Company	5	3	11	Brownrigg-Keller 2	Santa Fe Springs
Universal Consolidated Oil Co.	6	3	11	3	Santa Fe Springs
Mascot Oil Company	32	1	10	1	--------------------
Mission Hills Oil Company	5	2	15	1	--------------------
Nevada-Ventura Oil Syndicate	16	3	11	Rebai 2	--------------------
Oak Ridge Oil Company	--	4	13	Dominguez 1	--------------------
Standard Oil Company	15	3	11	1	--------------------
NAPA COUNTY:					
Humboldt Trading Company	20	8	3	1	--------------------
ORANGE COUNTY:					
Shell Co. of California	2	3	10	9	Brea Canyon
Dolke-Thomas Oil Company	27	3	10	1-B	Coyote Hills
Central Oil Company	2	6	11	Talbert 1	Huntington Beach
Shell Co. of California	34	5	11	4-A	Huntington Beach
Standard Oil Company	29	5	11	Bolsa 9	Huntington Beach
Standard Oil Company	29	5	11	Lomita 2	Huntington Beach
Standard Oil Company	2	6	11	16	Huntington Beach
Standard Oil Company	12	6	11	Thomson 2	Huntington Beach
Union Oil Co. of California	13	6	11	Reed 1	Huntington Beach
Union Oil Co. of California	34	3	9	8	Richfield
SAN MATEO COUNTY:					
Olson & Sage	Shoults Ranch			1	--------------------
SANTA BARBARA COUNTY:					
Palmer Union Oil Company	26	9	33	7-B	Cat Canyon
Shell Co. of California	31	9	33	92	Santa Maria
Tobin, Wm. F.	Lookout Park			2	Summerland
Tobin, Wm. F.	Lookout Park			3	Summerland
SONOMA COUNTY:					
Sage & Olson	--	4	7	2	--------------------
VENTURA COUNTY:					
Camarillo Oil & Drilling Co.	12	1	20	1	Conejo
Montebello Oil Company	4	3	19	24-A	Bardsdale
Ventura Star	24	4	9	1	Piru
Lincoln Oil and Gas Co.	21	4	21	26	Santa Paula
Ivers, H. A.	1	4	20	6	Sespe
Shell Co. of California	28	3	23	Gosnell 5	Ventura
Carey, E. R.	33	4	23	1	--------------------

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau publications have been made available for distribution:

Summary of Operations, California Oil Felds, June, 1922, Vol. 7, No. 12.
Mining in California, August, 1922 (Monthly), Vol. 18, No. 8.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XIV, State Mineralogist	6
Report XV, State Mineralogist	3
Report XVII, State Mineralogist	6
Mines and Mineral Resources of Del Norte, etc.	3
Mines and Mineral Resources of Fresno, etc.	1
Mines and Mineral Resources of Imperial, etc.	1
Mines and Mineral Resources of Alpine, etc.	4
Mines and Mineral Resources of El Dorado, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	2
Mines and Mineral Resources of Monterey, etc.	3
Mines and Mineral Resources of San Bernardino, etc.	2
Mines and Mineral Resources of Nevada County	6

Publications	Number distributed
Mines and Mineral Resources of Plumas County	4
Mines and Mineral Resources of Sierra County	3
Bulletin No. 6, California Gold Mill Practices	3
Bulletin No. 37, Gems, Jewelers Materials, Ornamental Stones of California	6
Bulletin No. 50, Copper Resources of California (Revised)	1
Bulletin No. 72, Geologic Formations of California	11
Bulletin No. 75, United States and California Mining Laws	1
Bulletin No. 76, Manganese and Chromium in California	2
Bulletin No. 78, Quicksilver Resources of California	4
Bulletin No. 85, Platinum Resources of California	10
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	57
Mining in California (Monthly), June, 1922, Vol. 18, No. 6	2400
Summary of Operations, California Oil Felds (Monthly), June, 1922, Vol. 7, No. 12	2700
County Maps and Registers of Mines	1
Inyo Geological Map	3
Minaret Map	1
Forest Map, Mounted	2
Geological Map of California, Mounted	12
Map Accompanying Bulletin No. 89	10
Plumas County Map	2
Lake County Map	1
Oil Field Maps	452

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 637 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

MINERAL PRODUCTION OF CALIFORNIA IN 1921.

SECTION ONE —— SUMMARY.

The total value of the mineral output of California for the year 1921 was $268,157,472, being an increase of $26,057,805 over the 1920 total of $242,099,667. There were fifty-one different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, herein, the salient features of 1921 compared with the preceding year, are: The continued increase in petroleum valuation; the increases in gold, silver, cement, crushed rock, and natural gas; decreases in copper, quicksilver, lead, the 'industrial' group, and the saline group. The net result was an increase in the grand total for all groups, of slightly over twenty-six million dollars value, as given above. Petroleum accounted for an increase of $24,743,288 due both to a larger quantity and a higher price per barrel.

With the exception of gold and silver, all other items in the metals group showed decreases. Of the 'structural' materials group, cement showed an increase of nearly 700,000 barrels in quantity and of $3,109,175 in value; miscellaneous stone (comprising crushed rock, sand, and gravel), an increase in aggregate tonnage and an increase of $1,031,083 in value; granite, an increase of $230,169 in value, magnesite, a decrease of 50% in value (to $511,102), with a 43% decrease in quantity.

Nearly all of the items in the 'industrial' materials group registered decreases, the heaviest loser being diatomaceous earth. With one exception, all of the products in the saline group decreased, especially borax, potash and soda. The exception was calcium chloride, a new item not previously reported to the State Mining Bureau as on the production list for California.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere of the earth. The total annual value of her output is surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. Of one item, at least, borax, California has long been the sole producer; and for many years was also the sole domestic source of chromite and magnesite. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

From data furnished the writer by the Industrial Accident Commission, it is estimated that there were employed in the mines, dredges, quarries, cement and brick plants, approximately 13,000 men during 1921, and approximately 25,000 men in the oil fields exclusive of refineries, making a total of approximately 38,000 men employed in the mineral industries in California last year. The production for the year of $268,157,472 worth of minerals, therefore, represents, in round numbers, an average output of $7,000 for every man employed, or an average of $8,300 per man in the oil fields and $5,000 per man in the other branches.

The following table shows the comparative yield of mineral substances of California for 1920 and 1921, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

Substance	1920		1921		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	66 tons	$2,740	410 tons	$19,275	$16,535+
Barytes	3,029 tons	20,795	901 tons	4,809	15,986—
Bituminous rock	5,450 tons	27,825	8,298 tons	43,192	15,367+
Borax	127,065 tons	2,794,206	50,136 tons	1,096,326	1,697,880—
Calcium chloride	----------	----------	683 tons	22,980	22,980+
Cement	6,709,160 bbls.	14,962,945	7,404,221 bbls.	18,072,120	3,109,175+
Brick and tile	----------	5,704,393	----------	5,570,875	133,518—
Chromite	1,770 tons	43,031	347 tons	6,870	36,161—
Clay (pottery)	203,997 tons	440,689	225,120 tons	362,172	78,517—
Coal	2,078 tons	5,450	12,467 tons	63,578	58,128+
Copper	12,947,299 lbs.	2,382,303	12,088,053 lbs.	1,559,358	822,945—
Dolomite	42,388 tons	132,791	31,195 tons	99,155	33,636—
Feldspar	4,518 tons	26,189	4,349 tons	28,343	2,154+
Fuller's earth	600 tons	6,000	1,185 tons	8,295	2,295+
Gems	----------	36,056	----------	10,954	25,102—
Gold	----------	14,311,043	----------	15,704,822	1,393,779+
Granite	----------	495,732	----------	725,901	230,169+
Graphite	[a]	[a]	[b]	[b]	[b] —
Gypsum	20,507 tons	92,535	37,412 tons	78,875	13,660—
Infusorial and diatomaceous earths	60,764 tons	1,056,260	[b]	[b]	[b] —
Iron ore	5,975 tons	40,889	1,970 tons	12,030	28,859—
Lead	4,903,738 lbs	392,300	1,149,051 lbs.	51,707	340,593—
Lime	463,144 bbls.	557,232	463,534 bbls.	610,619	53,387+
Limestone	90,120 tons	298,197	75,921 tons	305,912	7,715+
Lithia	10,046 tons	153,502	[b]	[b]	[b] —
Magnesite	83,695 tons	1,033,491	47,837 tons	511,102	522,389—
Magnesium salts	3,150 tons	107,787	4,153 tons	106,140	1,647—
Manganese ore	2,892 tons	62,323	1,005 tons	12,210	50,113—
Marble	29,531 cu. ft.	92,899	30,232 cu. ft.	98,395	5,496+
Mineral paint	779 tons	8,477	446 tons	4,748	3,729—
Mineral water	2,391,491 gals.	421,643	3,446,278 gals.	367,476	54,167—
Natural gas	58,567,772 M cu. ft.	3,898,286	67,043,797 M cu. ft.	4,704,678	806,392+
Onyx	----------	----------	2,569 cu. ft.	1,294	1,294+
Petroleum	103,377,361 bbls.	178,394,937	112,599,860 bbls.	203,138,225	24,743,288+
Platinum	477 fine oz.	68,977	613 fine oz.	58,754	10,223—
Potash	26,298 tons	1,465,463	14,806 tons	390,210	1,075,253—
Pumice and volcanic ash	1,537 tons	25,890	406 tons	6,310	19,580—
Pyrites	146,001 tons	530,581	110,025 tons	473,735	56,846—
Quicksilver	10,278 flasks	775,527	3,157 flasks	140,663	634,861—
Salt	230,638 tons	972,648	197,989 tons	832,702	139,946—
Sandstone	10,500 cu. ft.	2,300	10,150 cu. ft.	2,112	188—
Silica (sand and quartz)	25,324 tons	96,793	10,569 tons	49,179	47,614—
Silver	----------	1,859,896	----------	3,629,223	1,769,327+
Soapstone and talc	11,327 tons	221,362	8,752 tons	130,078	91,284—
Soda	32,407 tons	1,164,898	14,828 tons	438,996	725,902—
Stone, miscellaneous[c]	----------	6,803,557	----------	7,834,640	1,031,083+
Zinc	1,188,009 lbs.	96,229	846,184 lbs.	42,309	53,920—
Unapportioned	12,600	[a]12,600	----------	[b]726,122	496,140—
Total value	----------	$242,099,667	----------	$268,157,472	----------
Net increase	----------	----------	----------	----------	$26,057,805+

---

[a] Unapportioned—includes graphite and columbite (tantalum ore).

[b] Unapportioned—includes graphite, diatomaceous earth, and lithia.

[c] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel, and grinding-mill pebbles.

The following table shows the comparative value of the mineral production of the various counties in the state for the years 1920 and 1921:

County	1920	1921
Alameda	$1,947,880	$1,353,690
Alpine	840	925
Amador	2,010,200	2,368,464
Butte	641,562	669,830
Calaveras	1,880,050	1,525,201
Colusa	57,488	80,438
Contra Costa	2,082,053	1,622,732
Del Norte	11,781	6,029
El Dorado	186,432	112,756
Fresno	23,819,351	19,498,503
Glenn	134,707	103,197
Humboldt	159,796	138,597
Imperial	169,882	182,818
Inyo	3,889,400	1,460,218
Kern	89,121,581	100,840,933
Kings	29,870	5,722
Lake	63,553	174,389
Lassen	12,313	83,485
Los Angeles	26,975,163	31,704,941
Madera	122,925	467,667
Marin	335,745	318,776
Mariposa	271,031	342,601
Mendocino	26,110	44,722
Merced	24,800	33,550
Modoc	4,668	36,650
Mono	188,258	56,876
Monterey	126,449	170,155
Napa	230,141	195,239
Nevada	2,955,006	2,641,081
Orange	34,108,136	47,499,030
Placer	612,813	449,070
Plumas	2,082,662	1,798,461
Riverside	5,128,208	4,883,898
Sacramento	2,066,154	2,394,894
San Benito	1,483,024	1,386,093
San Bernardino	6,541,348	9,375,540
San Diego	794,229	501,393
San Francisco	80,353	41,562
San Joaquin	471,102	474,378
San Luis Obispo	405,604	129,791
San Mateo	293,103	257,092
Santa Barbara	10,538,611	10,190,929
Santa Clara	1,038,692	750,708
Santa Cruz	3,081,138	4,080,885
Shasta	1,108,538	841,262
Sierra	446,861	620,361
Siskiyou	229,115	93,147
Solano	2,930,614	3,030,198
Sonoma	287,245	175,551
Stanislaus	385,017	236,207
Sutter	54	54
Tehama	26,400	30,820
Trinity	562,105	456,882
Tulare	593,296	552,234
Tuolumne	513,914	554,483
Ventura	5,229,175	6,245,269
Yolo	9,472	14,829
Yuba	3,573,649	4,852,266
Total values	$242,099,667	$268,157,472

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines. Cement increased rapidly from 1902, while crushed rock, sand and gravel parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc, but all except silver have since declined; with structural materials and silver increasing in 1920–1921.

Total Mineral Production of California by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,689,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
Totals	$1,505,966,523	$587,548,208	$1,192,372,651

SECTION TWO —— FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up nearly 78% of the state's entire mineral output for the year 1921.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has as yet been recorded as utilized for fuel.

Comparison of values during 1920 and 1921 is shown in the following table:

	1920		1921		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	2,078 tons	$5,450	12.467 tons	$63,578	$58,128+
Natural gas	58,567,772 M cu. ft.	3,898,286	67.043.797 M cu. ft.	4,704,678	806.392+
Petroleum	103,377,361 bbls.	178,394,937	112,599,860 bbls.	203,138,225	24,743,288+
Total value		$182,298,673		$207,906,481	$25,607,808+

COAL (see April bulletin).

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary Oil & Gas Supervisor, Dec. 1919.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated.

The figures here given are certainly not over estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable. Gas traps of various size and design are in use. The gas which accompanies oil is richer than the so-called 'dry gas' occurring in strata which do not produce oil. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas development in California in recent years has been by the Standard Oil Company in the Elk Hills field in Kern County, northeast of the Midway district. Construction work was started in 1921 by the San Joaquin Light and Power Company on a large power unit at Buttonwillow, for the utilization of the Elk Hills natural gas to produce electric power. Heavy gas pressures have also been encountered by the American Oil Felds Company in prospect wells in the Buttonwillow district which is northeast of Elk Hills.

The new oil fields at Long Beach and Santa Fe Springs in Los Angeles County are showing up new gas resources which are already being utilized commercially. The presence of gas was indicated by several wells which 'went wild' while being drilled. At present, the General Petroleum Corporation from its 'Well No. Santa Fe 2' is selling 8,000,000 cubic feet per day, under a casing pressure of 650 pounds per square inch and a tubing pressure of 450 pounds. This well is capable of yielding 25,000,000 cubic feet per day, open flow. Another well of the same company is stated to be yielding 5,000,000 cubic feet per day.

Several counties produce gas which is not accompanied by oil, particularly Sacramento and San Joaquin, where it is mixed with manufactured gas for domestic service. The Tulare Lake district in Kings and Tulare counties also does not yield oil.

There is rather a wide variation in prices quoted for natural gas because such a large proportion is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have attempted to place a valuation on the gas that was thus used in 1921 gave from 3¢-20¢ per 1000 cubic feet. From the totals shown in the tabulation following herein, the average value for all fields in 1921 works out at approximately 7¢. Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25 h.p. engine, and 63,700 cu. ft. per day for heating a 70 h.p. steam boiler, which figures have been used in compiling this report.

NATURAL GAS, 1921.

County	M cu. feet	Value
Fresno	1,886,081	$190,181
Kern	40,136,930	1,926,797
Kings	2,090	980
Los Angeles	6,944,277	638,936
Orange	14,097,639	1,312,704
San Joaquin	204,057	79,571
Santa Barbara	1,544,892	145,179
Tulare	380	190
Ventura	2,127,476	360,443
Butte, Humboldt, Lake, Mendocino, Sacramento, Sutter, Yuba*	99,975	49,697
Totals	67,043,797	$4,704,678

*Combined to conceal output of an individual producer in each.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value	Year	M cubic feet	Value
1888	[a]12,000	$10,000	1906	168,175	$109,489
1889	[a]14,500	12,680	1907	169,991	114,759
1890	[a]41,250	33,000	1908	842,883	474,584
1891	[a]39,000	30,000	1909	1,148,467	616,932
1892	[a]75,000	55,000	1910	10,579,933	1,676,367
1893	[a]84,000	68,500	1911	[a]5,000,000	491,859
1894	[a] [b]85,080	79,072	1912	[a]12,600,000	940,076
1895	[a] [b]110,800	112,000	1913	14,210,836	1,053,292
1896	[a] [b]131,100	111,457	1914	16,529,963	1,049,470
1897	[a]71,300	62,657	1915	21,992,892	1,706,480
1898	[a]111,165	74,424	1916	28,134,365	2,871,751
1899	115,110	95,000	1917	44,343,020	2,964,922
1900	40,566	34,578	1918	46,373,052	3,289,524
1901	120,800	92,034	1919	52,173,503	4,041,217
1902	120,968	99,443	1920	58,567,772	3,898,286
1903	120,134	75,237	1921	67,043,797	4,704,678
1904	144,437	91,035			
1905	148,345	102,479	Totals	381,464,204	$31,242,282

[a] Quantity, in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline From Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields. More than 50 plants are in operation manufacturing gasoline by compression or absorption from this 'casing-head gas.' After the gasoline is extracted, the remaining 'dry gas' is taken into the pipe lines, by which it is distributed to consumers, both domestic and commercial.

In the Midway field, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to transmission through the gas pipe lines. Some concerns market casing-head gasoline separately, while others turn it into the oil pipe lines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery, where it is later regained. A total of 53,699,797 gallons of casing-head gasoline from all fields was reported by 47 companies, as made during 1921. This compares with 54,817,467 gallons by 39 companies in 1920. It was distributed by counties, as follows:

County	Gallons gasoline
Fresno	388,881
Kern	26,016,401
Los Angeles	1,528,764
Orange	12,739,714
Santa Barbara	10,527,321
Ventura	2,498,716
Total	53,699,797

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft.

Fields.

The largest natural gas field of commercial importance thus far developed in California is in western Kern County, followed by Orange, Los Angeles, Ventura, Fresno and Santa Barbara counties. The Midway Gas Company operates a 12-inch pipe line from the Midway field, a distance of 107 miles, to Los Angeles, where it supplies gas to local distributing companies. The Valley Natural Gas Company supplies gas to consumers in the Midway field and to local distributing companies at Fellows, Taft, Maricopa, Bakersfield, and the Kern River fields. One hundred million cubic feet of gas is daily run into commercial gathering lines from the Buena Vista and Elk Hills areas, Kern County. The greater part of this gas is used in the San Joaquin Valley for operating steam plants to generate electric power and for other industrial and domestic purposes. About one-third of that output is transported for use in the Los Angeles district.

Practically all of the gas consumed in Northern California and a large proportion of the gas used in the gas producing counties, including Los Angeles, is manufactured from crude petroleum or refinery residuum. Natural gases now being produced and utilized range in heat value from 800 to 1200 b. t. u. which is considerably higher than that of manufactured gas. In many cases the consumer buys a mixture of natural and manufactured gas. Under ordinary conditions, therefore, the price and the heat value of most of our gas for domestic and industrial uses is not only dependent upon available supplies of natural gas but also upon petroleum. The Santa Maria Gas and Power Company distributes gas around Santa Maria, from wells in the neighboring oil fields.

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins, 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins, 213, 285, 309, 317, 321, 322, 340. 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers, 116, 117.

Petroleum is the chief fuel resource of California, and California led all other states of the Union in the number of barrels of crude oil produced in 1921. California, with Oklahoma, has enjoyed the distinction in recent years of standing at the head of the oil list, on several occasions. Reports of the U. S. Geological Survey credit California and Oklahoma, each, with 23.83% and 23.84%, respectively, of the total petroleum yield of the United States in 1920. Texas was third with 21.65%. California's oils are nearly all of asphalt base.

The California law providing for the regulation of drilling and maintenance of oil and gas wells by the State Mining Bureau has been in effect since 1915, the chief aim being to protect the oil deposits from damage by water, and to aid producers in their work. A staff of technically trained men maintain offices in the various fields.

The crude oil production of California for 1921, as shown by the sworn statements made to the State Mineralogist for the Department of Petroleum and Gas, by the producers from 10,211 wells (except part of the Los Angeles City field, not under jurisdiction of the State Oil and Gas Supervisor), amounted to 112,406,847 barrels net. 'Net' means that a deduction of approximately 2% has been made for water. The oil consumed for fuel at the wells is also included. This shows an increase of 9,222,113 barrels over the similar net figures of 1920.

To the above amount, we have here added 193,013 barrels, being the output of various small operators in the Los Angeles City, not included in the reports to the Oil and Gas Supervisor, making a total for the year 1921 of 112,599,860 barrels, valued at $203,138,225. Compared with 1920, this is an increase of 9,222,499 barrels in quantity, and of $24,743,288 in value.

Features of 1921.

As in 1920, Kern, Orange and Ventura were the only counties which showed marked increases in the number of barrels of oil produced during 1921 over the previous year. Los Angeles County, though reporting a decrease in quantity, shows a higher total value than in 1920. In Fresno County, the quantity decreased over 3,000,000 barrels, and in Santa Barbara, approximately 338,000 barrels. But for the strike of oil-field workers in September-October in Kern and Fresno counties, the state's total yield for 1921 would probably have exceeded 120,000,000 barrels. The highest month's production during the year was 10,450,131 barrels in May. During that month, 42 wells in the easterly portion of the Elk Hills, Kern County, yielded 1,794,156 barrels of oil; which meant that for that period less than 0.5% of the total number of oil wells of California produced 17% of the oil.

> [1]"From the viewpoint of the oil industry as a whole, including producing and marketing interests alike, the strike resulted beneficially. It caused a large quantity of oil, not needed in the market, to be left in its natural underground storage. Surface storage was being filled at a rapid rate and the general industrial dullness threatened further reductions in the price of crude at the well. The price was reduced 25 cents per barrel on May 13, 1921, and another 25 cents per barrel on August 3, 1921. Considering total lifting costs, the smaller operator, at least, was facing almost the minimum price per barrel at which he could operate with profit and a further drop in the price of crude would have caused him either to shut down or operate at a loss.
>
> "During the period January 1 to June 30, 1921, the fields later affected by the strike produced 40,071,977 barrels of oil and 32,179,694 barrels of water. This represented two-thirds of the oil produced in the state and almost four-fifths of the water lifted during the process of producing oil."

The subsequent investigations by engineers of the Department of Petroleum and Gas have shown that, as a whole, the strike shut-down simply deferred production without greatly affecting the ultimate recovery of oil. In many cases there was a flush production for several months, after operations were resumed, which almost enabled producers to regain, during those months, the production deferred during suspension of operations. The investigation also shows that there has been no marked change in water conditions following restoration of normal operations.

The record of operations during 1921 shows that 55 per cent of the drilling, in proved fields, was concentrated in the four newer fields, Elk Hills, Huntington Beach, Long Beach and Richfield. One hundred thirty-one notices were filed for wildcat wells and 181 notices were filed for drilling shallow wells at Devils Den and Conejo. Twelve hundred eighty-seven notices for new wells were filed during 1921.

---

[1] Collom, R. E., Resumé of oil operations in 1921. Summary of Operations, Feb., 1922, p. 8.

Outlook for 1922.

For the first six months of 1922, the average production per day for California was 338,000 barrels, as against an average daily consumption of 293,000 barrels; a difference of 45,000 barrels, daily, attributable partly to over-production and partly to subnormal consumption. Although oil has been continuously run into storage since January, 1921, and is being stored at the present time at a rate of nearly 3,000,000 barrels monthly, practically as many new wells have been reported ready to drill during the first six months of 1922 as for a similar period in 1921.

In July of the current year (1922) the three new fields, Huntington Beach, Long Beach and Santa Fe Springs were producing 25,000 barrels, 66,000 barrels, and 15,000 barrels, daily, respectively. At Santa Fe Springs, a reasonable estimate based on yield of wells being completed and at least 60 more being drilled, is that 28 new wells will be brought in by the end of September with about 32,000 barrels per day.

As to quantities of oil destined for storage the potentialities of the situation are summarized[1] as follows:

> "One thousand producing wells are now shut down in certain fields of the San Joaquin valley and in Santa Barbara County. The combined production from these wells averages 36,500 barrels daily. Present active production averages 45,000 barrels daily in excess of consumption. Estimated new production due within the next 60 days from Santa Fe Springs and Long Beach adds 62,000 barrels per day. The possible production from other new drilling such as at Huntington Beach and in Naval Reserves No. 1 and No. 2 in Kern County is not included in the estimate.
>
> "By the middle of September, at rates of consumption which have obtained during the first six months of 1922 oil should be moving into storage at the rate of at least 100,000 barrels daily or over 3,000,000 barrels per month. The rate of elimination of this hundred thousand barrels excess will depend upon the rapidity of decline of flush production of new fields. With this excess eliminated there will still be a potential over-production of 36,500 barrels per day in the older producing wells which have been shut down."

In June a total of 620 wells had been shut in, mainly in the older fields of the San Joaquin Valley and in the Santa Maria district, Santa Barbara County. (See p. 269, *ante.*)

Production Figures.

The following table gives the production and value by counties for 1921, compared with the 1920 figures:

TABLE A.

Production and Value of Oil, by Counties.

County	1920		1921	
	Barrels	Value	Barrels	Value
Fresno	15,375,454	$22,801,798	12,161,565	$18,643,679
Kern	50,660,438	86,831,991	57,434,945	97,639,407
Los Angeles	14,026,536	21,488,653	12,395,605	25,795,254
Orange	15,462,741	33,059,340	22,929,466	45,996,509
San Luis Obispo	42,511	59,515	30,725	43,691
San Mateo	322	966	322	966
Santa Barbara	5,803,583	9,140,643	5,465,942	9,122,657
Santa Clara	16,095	23,901	13,964	26,943
Ventura	1,989,681	4,988,130	2,167,326	5,869,119
Totals	103,377,361	$178,394,937	*112,599,860	$203,138,225

*See p. 437, *ante.*

---

[1] Collom, R. E., Weekly Press Bulletin, Dept. Oil and Gas, Cal. State Mining Bureau, July 15, 1922.

TABLE B.

Average Price of Oil per Barrel, by Counties, 1914-1921.

County	1914	1915	1916	1917	1918	1919	1920	1921
Fresno	$0.452	$0.545	$0.516	$0.825	$1.191	$1.293	$1.483	$1.533
Kern	.409	.423	.641	.893	1.252	1.350	1.714	1.700
Los Angeles	.550	.629	.651	1.176	1.340	1.380	1.532	2.081
Orange	.675	.512	.663	1.003	1.412	1.860	2.138	2.006
San Luis Obispo	--------	--------	.450	.926	.905	1.040	1.400	1.422
Santa Barbara	.460	.611	.794	.808	1.235	1.125	1.575	1,669
Santa Clara	.530	.666	.666	1.387	1.700	1.600	1.485	1.930
Ventura	1.050	.855	1.045	1.318	1.480	1.635	2.507	2.708
State average	$0.461	$0.479	$0.636	$0.908	$1.278	$1.409	$1.726	$1.804

The low price in Santa Barbara County for 1919 and 1920 was due to a large production of 8° to 10° gravity oil from the Casmalia field, which brought only about 50¢ per barrel in 1919 and 39¢ in 1920. For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil. In 1919, the average value for all grades worked out at a figure corresponding to the quotations for 28° oil, due to the fact that the increased output of that year was mainly from the Montebello field in Los Angeles County which yielded high-gravity oil. The 1920 figure of $1.726 corresponds approximately to the average of quotations for 24°-25° oil for the year; and the 1921 figure of $1.804, to 26° quotations.

Figures published by the Standard Oil Company[1] give a total for the state of 114,849,924 barrels in 1921 as against their total of 105,721,186 barrels for 1920. The Independent Producers Agency reports[2] 114,566,901 barrels for 1921, compared with 105,618,706 barrels for 1920. The reason that the State Mining Bureau's totals are less than those of the Standard and Agency is due to the fact that a deduction of approximately 2% has been made for water content in the oil as pumped and as reported from pipe-line runs.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA.

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and even utilized in a small way early in the history of California. According to Hanks,[3] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

[4]"Work was commenced in Pico Cañon in 1875, by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877, Pico averaged 40-50 bbl. daily, and Ventura, 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

---

[1] Standard Oil Bulletin, January, 1922, p. 11.

[2] Press Bulletin, January, 1922.

[3] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.

[4] *Idem*, p. 301.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

TABLE C.

Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	[a]175,000	[b]$472,500	1900	4,329,950	$4,152,928
1876	12,000	30,000	1901	7,710,315	2,961,102
1877	13,000	29,250	1902	14,356,910	4,692,189
1878	15,227	30,454	1903	24,340,839	7,313,271
1879	19,858	39,716	1904	29,736,003	8,317,809
1880	40,552	60,828	1905	34,275,701	9,007,820
1881	99,862	124,828	1906	32,624,000	9,238,020
1882	128.636	257.272	1907	40,311,171	16,783,943
1883	142,857	285,714	1908	48,306,910	26,566,181
1884	262,000	655,000	1909	58,191,723	32,398,187
1885	325,000	750,750	1910	77,697,568	37,689,542
1886	[a]377,145	[b]870,205	1911	84,648,157	40,552,088
1887	678,572	1,357,144	1912	89,689,250	41,868,344
1888	690,333	1,380,666	1913	98,494,532	48,578,014
1889	303,220	368,048	1914	102,881,907	47,487,109
1890	307,360	384,200	1915	91,146,620	43,503,837
1891	323,600	401,264	1916	90,262,557	57,421,334
1892	385,049	561,333	1917	95,396,309	86,976,209
1893	470,179	608,092	1918	99,731,177	127,459,221
1894	783,078	1,064,521	1919	101,182,962	142,610,563
1895	1,245,339	1,000,235	1920	103,377,361	178,394,937
1896	1,257,780	1,180,793	1921	112,599,860	203,138,225
1897	1,911,569	1,918,269			
1898	2,249,088	2,376,420	Totals	1,456,185,961	$1,195,979,174
1899	2,677,875	2,660,793			

---

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.

[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

The following table is compiled from the monthly statements contained in the Standard Oil Bulletin:

TABLE D.

Well Operations, by Fields, 1921.

	Producing Dec., 1920	Producing Dec., 1921	Completed during year	Abandoned during year	Barrels per well produced per day, Dec., 1920
Kern River	2,152	2,207	75	2	8.7
McKittrick	352	350	3	4	16.9
Midway-Sunset	2,509	2,707	260	17	47.1
Lost Hills-Belridge	591	612	15	1	16.3
Coalinga	1,293	1,176	54	12	28.9
Santa Maria-Lompoc	406	416	20	2	34.3
Ventura and Newhall	513	526	43		12.8
Los Angeles and Salt Lake	666	671	9	1	5.2
Whittier-Fullerton	990	1,116	147	8	79.7
Huntington Beach		51	78		292.9
Summerland	140	137			1.1
Watsonville and miscellaneous	9	9			7.2
Totals	9,621	9,978	704	47	*32.6

*State average.

Specific Gravities of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Oil below 18° Baumé may be considered as largely unrefinable, or fuel oil, while the lighter oils yield varying amounts of refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County.

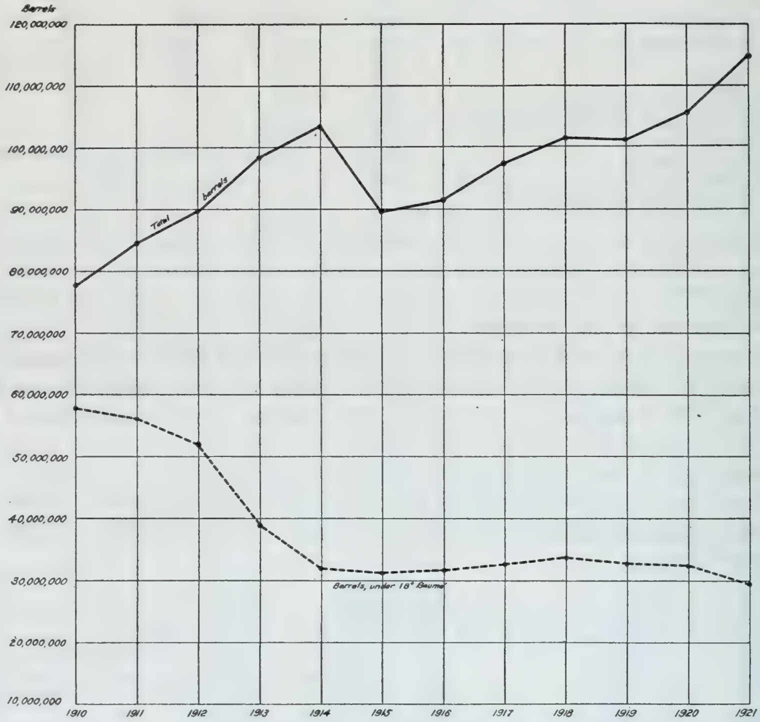
TABLE E.

Production of Light and Heavy Oil, by Fields, 1921.

Field	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	6,715,680		6,715,680
McKittrick	2,056,101		2,056,101
Midway-Sunset	9,473,951	37,397,789	46,871,740
Lost Hills-Belridge	984,034	2,277,247	3,261,281
Coalinga	4,681,777	7,658,860	12,340,637
Santa Maria-Lompoc	2,604,866	2,958,458	5,563,324
Ventura County and Newhall	88,861	2,286,618	2,375,479
Los Angeles and Salt Lake	1,213,291	131,635	1,344,926
Whittier-Fullerton	1,292,885	30,388,532	31,681,417
Huntington Beach-Signal Hill	104,744	2,456,405	2,561,149
Summerland	54,155		54,155
Watsonville	24,035		24,035
Totals	29,294,380	85,555,544	114,849,924

Reference to the accompanying chart reveals the fact that a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18° Baumé as the dividing line. The upper line represents the total number of barrels of crude oil of all grades produced each year; and the lower line, the number of barrels each year of oil below 18° Baumé. The area between the base line and the first 'curve' represents the quantity of heavy oil, and the area between the two 'curves' represents the quantity of light crudes.

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it has remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low–25% high in 1914 to 25% low–75% high in 1921. This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as noted in a preceding paragraph. Its effect upon the relative situation between production and consumption has also been important. It has been a fortunate development, especially the past four years, in view of the



RELATIVE PRODUCTION OF LIGHT AND HEAVY CRUDE OILS IN CALIFORNIA
1910-1921

increased demand for refinery products (gasoline, in particular), and the lessened demand for fuel oil the past two years owing in part to the shutting down of the western copper smelters which were large consumers of California fuel oil.

The beginning of 1921 was marked by the discontinuance of drawing on storage, owing to the current production of crude oil overbalancing consumption. This still continues, so that on December 31, 1921, the stock on hand amounted to 35,021,912 barrels[1], an increase of 12,781,641 barrels over the 22,240,271 barrels on hand December 31, 1920.

Operating Data.

The following tabulation (Table F) is compiled from data published by the Department of Petroleum and Gas,[2] semiannually, and here combined to show the entire year's operations for all the fields. The 'districts' are the geographical subdivisions as administered by the Department.

The second column in the second half, designated 'potential,' was inserted to show the potential number of wells in the areas affected by the strike of September-October as compared with the number actually producing during that period.

It will be noted that the state average yield of oil per well per day was 39.5 barrels for the first six months and 40.4 barrels for the second. This is somewhat higher than the figure of 32.6 barrels average for December derived from Standard Oil Company data and shown in Table D, on a preceding page. This is probably due to using a 30-day basis in Table D for the operating period, whereas Table F takes account of the days that wells were nonproducing owing to repairs or other causes.

Financial and Operating Conditions of California Oil Fields, 1921.

Financial results of the oil business during 1921 are shown by the following tables. The features worthy of mention are: (1) the higher price received for the year as shown by the state average of all grades; this, too, in spite of the average being slightly lower for some fields in 1921 compared with 1920, also notwithstanding two drops of 25¢ per barrel, each, in quotations during the year. (2) a slight increase in the total amount of dividends paid. (3) decreases in the number of barrels per well per day yield (see Table I), for all 'fields' except Orange County which increased, and the Sunset-Maricopa field which held its own. (4) slightly higher operating costs in most fields.

With reference to Table I, it should be noted that although it lacks data from the larger operators who have refineries and with interests in more than one field, yet the data given are of economic value and interest in that they indicate the conditions prevailing among the smaller companies and operators.

---

[1] Standard Oil Bulletin, January, 1922.

[2] Seventh Annual Report: Monthly summary of operations, Aug., 1921, p. 11; Feb., 1922, pp. 6–7.

TABLE F.

Production and Operating Data of California Oil Fields, 1921.

Field	January 1 to June 30						July 1 to December 31						
	Average number of producing wells	Oil (bbl.)	Number of days producing	Production per well per day, barrels		Percentage of time wells produced	Average number of producing wells		Oil (bbl.)	Number of days producing	Production per well per day, barrels		Percentage of time wells produced
				Oil	Water		Actual	Potential			Oil	Water	
District No. 1—													
Beverly Hills	15	82,362	2,554	32.3	38.7	94.1	15	----------	70,137	2,538	27.6	34.2	92.0
[1]Brea-Olinda	405	3,162,573	68,389	46.5	9.5	93.1	396	----------	2,973,352	66,282	44.8	9.6	90.9
Coyote Hills	220	3,698,048	36,687	100.8	21.9	92.5	228	----------	3,664,460	39,831	92.0	22.7	95.0
Huntington Beach	16	612,469	1,188	51.5	52.5	41.1	59	----------	1,975,757	6,271	315.1	5.4	57.7
Long Beach	1	2,318	5	463.6	----------	100.0	4	----------	82,400	271	304.1	1.0	36.8
Montebello	131	4,631,400	22,774	203.4	21.1	96.1	143	----------	4,366,894	24,686	176.9	26.5	93.8
Newhall	76	48,612	11,943	4.1	13.1	86.2	74	----------	44,583	12,138	3.7	13.0	89.1
Richfield	83	3,347,998	11,951	280.5	10.9	79.5	124	----------	4,761,763	19,412	245.3	6.7	85.1
Salt Lake	249	446,568	37,765	11.7	9.8	83.7	252	----------	454,268	42,565	10.7	9.0	91.8
Santa Fe Springs	1	13,557	177	76.6	0.9	97.8	2	----------	195,239	112	1,743.3	9.3	30.4
Whittier	167	433,964	26,014	16.6	21.1	77.6	173	----------	576,359	26,527	21.7	20.4	83.3
Totals	1,364	16,479,869	219,447	117.1	18.1	88.8	1,470	----------	19,165,212	240,623	79.6	14.7	89.0
District No. 2—													
Bardsdale	136	216,878	23,221	9.3	1.1	93.0	138	----------	212,439	23,995	8.8	1.2	94.0
Conejo	29	14,958	1,429	10.4	25.1	56.0	28	----------	3,691	4,544	0.8	3.1	88.0
Ojai	61	40,378	10,517	3.8	2.6	97.0	59	----------	39,733	9,987	3.9	2.5	92.0
Piru	78	60,089	13,282	4.5	5.3	84.0	80	----------	60,007	13,888	4.3	6.1	94.0
Santa Paula	50	18,764	8,305	2.2	0.8	91.0	50	----------	18,085	8,177	2.2	0.8	89.0
Sespe	14	23,139	4,147	5.5	0.8	92.0	25	----------	23,712	4,421	5.3	0.7	94.0
Simi	53	58,388	8,956	6.5	1.5	87.0	55	----------	55,136	9,630	5.7	1.6	94.0
South Mountain	26	547,870	4,265	128.0	----------	80.0	28	----------	663,569	4,890	135.7	----------	94.0
Ventura	21	82,240	3,460	23.7	89.4	87.0	22	----------	69,725	3,553	19.6	61.0	89.0
Totals	468	1,062,704	77,582	13.6	6.3	92.0	485	----------	1,146,097	83,085	13.7	4.7	94.0
District No. 3—													
Arroyo Grande	19	22,547	2,217	10.3	5.0	64.0	22	----------	19,031	2,831	6.7	12.0	68.0
Casmalia	90	772,303	14,113	54.6	187.5	87.0	92	----------	771,595	15,831	48.7	168.5	93.0
Cat Canyon	44	411,864	6,850	60.0	9.9	86.0	47	----------	396,016	7,052	56.2	12.0	80.0
Half Moon Bay	2	127	187	0.7	----------	52.0	2	----------	461	368	1.2	----------	50.0

Lompoc	27	244,524	4,018	61.0	101.4	82.0	27	----------	243,245	3,900	62.3	86.0	77.0
Santa Maria	234	1,378,294	36,218	38.0	33.4	83.0	240	----------	1,295,398	36,967	35.0	33.8	84.0
Sargent	9	11,465	1,629	7.1	0.1	100.0	8	----------	8,983	1,361	6.6	----------	93.0
*Summerland	135	27,859	22,754	1.2	13.2	93.0	135	----------	27,760	22,754	1.0	12.3	93.0
Totals	560	2,868,983	87,986	32.7	53.4	80.0	573	----------	2,762,489	91,064	30.3	51.4	80.0
District No. 4—													
Belridge-Lost Hills	580	1,906,439	96,725	19.7	19.0	92.1	485	598	1,277,056	69,162	18.5	17.2	62.8
Elk Hills	68	10,193,318	10,386	891.4	0.6	84.0	121	128	7,797,144	19,373	402.5	1.6	82.3
Kern River	2,123	3,687,425	358,092	10.3	43.6	93.2	2,114	2,191	2,743,290	295,696	9.3	48.5	73.3
McKittrick-Temblor	325	1,253,487	53,783	23.3	78.2	91.4	268	318	872,940	38,294	22.8	71.9	65.4
Midway-Sunset	2,486	15,462,682	416,423	37.1	19.4	92.5	2,555	2,637	13,167,946	342,468	38.5	20.0	70.6
Totals	5,582	32,503,351	935,409	34.75	31.8	92.6	5,543	5,872	25,858,376	764,993	33.8	32.9	70.8
District No. 5—													
Coalinga	1,329	7,468,626	219,897	33.9	11.0	91.4	1,233	1,360	5,181,151	159,555	32.47	9.61	70.3
Grand totals	9,176	60,383,533	1,540,351	39.5	26.6	92.2	9,304	----------	54,113,325	1,339,330	40.4	26.4	78.2

[1] Includes Puente field.

*Estimated.

Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. There is nothing to indicate that unnatural causes or manipulation have affected the profits of one producer against another. It may be noted that both price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is obtained from some of the Ventura wells.

TABLE G.

Capitalization.

Field	Number of companies considered*	Per cent of total product of field	Capital	
			Cash	Property
Fresno County—				
Coalinga	64	25	$2,851,778	$31,245,719
Kern County—				
Kern River	55	32	6,399,668	5,162,694
Midway	69	23	6,687,655	48,961,549
Sunset-Maricopa	32		2,882,914	6,775,518
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	61	52	2,690,394	13,914,465
Los Angeles County	63	16	6,570,759	13,452,081
Orange County	58	21	10,147,109	12,053,349
Santa Barbara County	21	31	2,378,681	6,288,228
Ventura County	46	74	1,365,207	10,025,171
Subtotals	469		$41,974,165	$147,878,774
Miscellaneous and marketing companies[1]	117	70	177,932,004	117,931,014
Totals	586		$219,906,169	$265,809,788

*See Table I, following.

[1] Includes companies having refineries, and those operating in several fields whose data could not be segregated as to counties or fields.

TABLE H.

Dividends Paid by Oil Companies, 1916-1921.

Field	1916		1917		1918		1919		1920		1921	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Coalinga	12	$217,949	20	$712,331	23	$1,055,600	24	$1,352,969	29	$1,297,694	24	$1,142,767
Kern River	23	405,556	22	306,508	31	609,293	27	1,235,877	26	783,625	28	390,794
Midway	29	1,207,974	34	1,938,769	42	3,015,862	32	8,360,447	39	7,096,819	34	4,311,539
Sunset and Maricopa	5	241,200	14	682,644	15	638,926	15	595,535	14	691,611	18	960,459
McKittrick, Belridge, Lost Hills, Devils Den, Elk Hills	7	434,184	14	837,129	12	708,984	9	548,224	12	1,231,045	13	2,603,490
Santa Barbara County	7	293,025	6	923,228	5	286,768	5	355,490	7	312,332	5	400,535
Ventura County	5	126,812	3	71,637	2	4,400	4	120,584	5	559,942	6	1,362,210
Los Angeles County	12	1,222,598	16	3,079,447	14	1,201,021	17	2,373,403	20	3,282,497	11	562,224
Orange County											11	1,395,158
Subtotals	100	$4,149,298	129	$8,551,693	144	$7,520,854	133	$14,942,529	152	$15,255,565	150	$13,129,176
Miscellaneous and marketing companies[1]	13	*38,383,270	12	#40,981,214	11	19,984,138	26	20,476,322	9	31,072,321	11	35,886,119
Totals	113	$42,532,568	141	$49,532,907	155	$27,504,992	159	$35,418,851	161	$46,327,886	161	$49,015,295

*Includes a 50 per cent stock dividend of the Standard Oil Company.
#Includes a 33⅓ per cent stock dividend of the Standard Oil Company.
[1] See Table G, preceding.

TABLE I.

Average Prices of Light and Heavy Oils, and Operating Data, 1921.

Field	Price				Operating data					
					All companies considered*			Dividend companies‡		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Coalinga	$1.429	$1.786	$1.533	$1.521	16.7	$10.24	$0.613	16.5	$10.18	$0.617
Kern River	1.390	------	1.390	1.430	8.0	3.40	0.425	9.9	4.63	0.468
Midway	1.381	1.883	1.765	1.942	23.0	10.07	0.438	30.7	14.95	0.487
Sunset and Maricopa	1.593	2.183	1.764	1.622	19.1	13.52	0.708	14.8	9.61	0.649
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	1.387	1.920	1.691	1.684	18.5	6.68	0.361	19.0	5.70	0.300
Los Angeles County	1.617	2.156	2.081	2.063	11.5	13.21	1.149	16.0	17.71	1.107
Orange County	1.085	2.128	2.006	2.239	42.1	37.05	0.880	28.6	28.20	0.986
Santa Barbara County	1.422	1.764	1.669	1.926	25.3	13.16	0.520	19.8	10.71	0.541
Ventura County	1.542	2.726	2.708	2.723	19.6	15.97	0.815	17.9	12.01	0.671

*See Table G, preceding. Does not include companies with refineries, nor those operating in several fields whose data could not be segregated as to counties or fields. The data given are of value, however, as showing the conditions obtaining among the smaller operators.

‡See Table H, preceding.

It should be noted that in the case of a county like Ventura, with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

Proved Oil Land.

The area of proved oil land increased during 1921 to a total of 109,214 acres compared with 94,567 acres in 1920. Kern, Los Angeles, Orange and Ventura counties were the important contributors to the increase. The acreage was distributed by counties as follows:

TABLE J.

County	Land (acres)	County	Land (acres)
Fresno	14,356	Santa Barbara	9,343
Kern	68,700	Santa Clara	80
Los Angeles	4,613	Ventura	3,940
Orange	7,410		
San Luis Obispo	772	Total	109,214

SECTION THREE — METALS.

The total value of metals produced in California during 1921 was $21,211,079. The chief of these is, and always has been, gold, followed in order in 1921 by silver, copper, quicksilver, platinum, lead, zinc, manganese ore, and iron ore. There was no production of antimony, cadmium, molybdenum, tin, nor tungsten, which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has as yet been no commercial output of them. The above-noted total for this group is a net increase of $1,221,592 over the 1920 total of $19,989,487, due to increases registered by both gold and silver while the rest showed decreases.

California leads all states in the Union in her gold production, and the precious metal is widely distributed throughout the state. Thirty-one of the fifty-eight counties reported an output in 1921 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the new Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

A comparison of the 1921 metal output with that of the 1920 is afforded by the following table:

	1920		1921		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Copper	12,947,299 lbs.	$2,382,303	12,088,053 lbs.	$1,559,358	$822,945—
Gold		14,311,043		15,704,822	1,393,779+
Iron ore	5,975 tons	40,889	1,970 tons	12,030	28,859—
Lead	4,903,738 lbs.	392.300	1,149,051 lbs.	51,707	340,593—
Manganese ore	2,892 tons	62,323	1,005 tons	12,210	50,113—
Platinum	477 fine oz.	68,977	613 fine oz.	58,754	10,223—
Quicksilver	10,278 flasks	775.527	3,157 flasks	140,666	634,861—
Silver		1,859,896		3,629,223	1,769,327+
Zinc	1,188,009 lbs	96,229	846,184 lbs.	42,309	53,920—
Total value		$19,989,487		$21,211,079	
Net increase					$1,221,592+

ALUMINUM (see May bulletin).

ANTIMONY (see May bulletin).

ARSENIC (see May bulletin).

BISMUTH (see May bulletin).

CADMIUM (see May bulletin).

COBALT (see May Bulletin).

COPPER.

Bibliography: State Mineralogist Reports VIII–XVII (inc.) Bulletins 23, 50.

Copper is second only to gold, among the metals produced in California. For many years Shasta was the leading county in the output of the red metal, but in 1919 Plumas advanced to first place, which it has since retained. This was due to the maintenance of output level by the Engels property in Plumas County and to the shutting down of the Mammoth, Mountain and Afterthought groups in Shasta County. The Engels ore is treated by flotation and the concentrate shipped to Utah plants for smelting. The fact that the Engels ore carries appreciable values in gold and silver is an important factor in the company's maintenance of operations. A small yield of copper in 1921 was also reported from Inyo, San Bernardino and Mono counties.

Although the copper property of the Mountain Copper Company was nonproductive in 1921, a part of the year's copper credited to Shasta County was obtained as a by-product from pyrite which had been sold and utilized in the manufacture of sulphuric acid, after which the cinder was smelted at other plants. Some copper was also obtained from matte made by the Shasta Zinc and Copper Company at Winthrop (Bully Hill) in their reverberatory operations for the production of zinc oxide.

The state's total for 1921 amounted to 12,088,053 pounds, valued at $1,559,358, being slightly less than the 1920 figure of 12,947,299 pounds, and 33% less in total value, due to the lower average prices for the metal prevailing in 1921—12.9¢ as against 18.4¢ in 1920. This was lower than the pre-war price of 13.3¢ of the year 1913. The high-level year was 1917 with an average of 27.3¢. With the notable exception of the Engels group in Plumas County, all of California's important copper producers have been closed down for over two years owing to the unfavorable market, a condition which is world-wide. The other western copper-producing states, Arizona, Montana, Nevada and Utah, are in a similar position.

Distribution of the 1921 copper output, by counties, was as follows:

County	Pounds	Value
Inyo	45,725	$5,898
Mono	2,940	379
Plumas	11,584,216	1,494,364
San Bernardino	17,054	2,200
Shasta	437,593	56,449
Calaveras, Orange*	525	68
Totals	12,088,053	$1,559,358

*Combined to conceal output of a single operator in each.

Copper Production of California, by Years.

Amount and value of copper production in California annually since such records have been compiled by the State Mining Bureau is given in the following tabulation:

Year	Pounds	Value
1887	1,600,000	$192,000
1888	1,570,021	235,303
1889	151,505	18,180
1890	23,347	3,502
1891	3,397,455	424,675
1892	2,980,944	342,808
1893	239,682	21,571
1894	738,594	72,486
1895	225,650	21,901
1896	1,992,844	199,519
1897	13,638,626	1,540,666
1898	21,543,229	2,475,168
1899	23,915,486	3,990,534
1900	29,515,512	4,748,242
1901	34,931,788	5,501,782
1902	27.860,162	3,239,975
1903	19,113,861	2,520,997
1904	29,974,154	3,969,995
1905	16,997,489	2,650,605
1906	28,726,448	$5,522,712
1907	32,602,945	6,341,387
1908	40,868,772	5,350,777
1909	65,727,736	8,478,142
1910	53,721,032	6,680,641
1911	36,838,024	4,604,753
1912	34,169,997	5,638,049
1913	34,471,118	5,343,023
1914	30,491,535	4,055,375
1915	40,968,966	7,169,567
1916	55,809,019	13,729,017
1917	48,534,611	13,249,948
1918	47,793,046	11,805,883
1919	22,162,605	4,122.246
1920	12,947,299	2,382,303
1921	12,088,053	1,559,358
Totals	828,331,555	$138,203,090

GOLD (see July bulletin).

IRIDIUM (see under Platinum).

IRON (see April bulletin).

LEAD.

Bibliography: State Mineralogist Reports IV, VIII–XV (inc).

Lead production in California in 1920 decreased to less than one-fourth that of the preceding year. The principal yield was from lead-silver ores from Inyo, Mono and San Bernardino counties. The average price for the year was 4.5¢ per pound, as compared with 3.9¢ in 1913, and the high-level average of 8.7¢ per pound in 1917.

The 1921 production was distributed by counties, as follows:

County	Pounds	Value
Inyo	1,052,253	$47,351
Mono	42,962	1,933
Plumas	2,961	133
San Bernardino	22,812	1,027
Calaveras, Orange and Shasta*	28,063	1,263
Totals	1,149,051	$51,707

*Combined to conceal output of a single operator in each.

Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1887	1,160,000	$52,200	1906	338,718	$19,307
1888	900,000	38,250	1907	328,681	16,690
1889	940,000	35,720	1908	1,124,483	46,663
1890	800,000	36,000	1909	2,685,477	144,897
1891	1,140,000	49,020	1910	3,016,902	134,082
1892	1,360,000	54,400	1911	1,403,839	63,173
1893	666,000	24,975	1912	1,370,067	61,653
1894	950,000	28,500	1913	3.640,951	160,202
1895	1,592,400	49,364	1914	4,697,400	183,198
1896	1,293,500	38,805	1915	4,796,299	225,426
1897	596,000	20,264	1916	12,392,031	855,049
1898	655,000	23,907	1917	21,651,352	1,862,016
1899	721,000	30,642	1918	13,464,869	956,006
1900	1,040,000	41,600	1919	4,139,562	219,397
1901	720,500	28,820	1920	4,903,738	392,300
1902	349,440	12,230	1921	1,149,051	51,707
1903	110,000	3,960			
1904	124,000	5,270	Totals	96,754,940	$5,990,776
1905	533,680	25,083			

MANGANESE (see August bulletin).

MOLYBDENUM (see May bulletin).

NICKEL (see May bulletin).

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM (see August bulletin).

QUICKSILVER (see August bulletin).

SILVER (see July bulletin).

TIN (see May bulletin).

TUNGSTEN (see May bulletin).

VANADIUM (see May bulletin).

ZINC.

Bibliography: State Mineralogist Reports XIV, XV, XVII. Bulletins 38, 67.

The production of zinc in California in 1921 amounted to 846,184 pounds, worth $42,309 at the average price of 5.0¢ quoted for the metal. This output represents the metal contained in zinc oxide prepared at the plant of the Shasta Zinc and Copper Company. The oxide was obtained directly from zinc-copper ore by roasting in a reverberatory, collecting in a bag-house, and subsequent refining. The resultant product was sold to paint and rubber manufacturers; and there appears to be a promising future for such business on the Pacific Coast. There are already several automobile tire plants in operation in California.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20%, a large portion is rolled into plates and sheets, and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1915	13,043,411	$1,617,383
1907	177,759	10,598	1916	15,950,565	2,137,375
1908	54,000	3,544	1917	11,854,804	1,209,190
1909	--------	--------	1918	5,565,561	506,466
1910	--------	--------	1919	1,384,192	101.046
1911	2,679,842	152,751	1920	1,188,009	96,229
1912	4,331,391	298,866	1921	846,184	42,309
1913	1,157.947	64,845			
1914	399,641	20,381	Totals	58,839,306	$6,273,549

SECTION FOUR —— STRUCTURAL MATERIALS.

Bibliography: State Mineralogist Reports XIV, XV, XVII. Bulletin 38. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1921 was valued at $33,477,120, as compared with a total value of

$29,723,405 for the year 1920, the increase being due to continued activity in all building and construction operations which followed the release of war-time restrictions.

Deposits of granite, marble and other building stones are distributed widely throughout this state, and transportation and other facilities are gradually being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though from 1914 to 1918 there was a falling off common to all building materials. The 1921 output established a new high-level mark, both in quantity and value.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides recently taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, with only a slight decrease in 1921. This item will, no doubt, continue to be an important one, and of course a market for fire and fancy brick of all kinds will never be lacking.

Fifty-five counties contributed to this structural total for 1921, and there is not a county in the state which is not capable of some output of at least one of the materials under this classification.

The following table gives the comparative figures for the amounts and value of structural materials produced in California during the years 1920 and 1921:

Substance	1920		1921		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	5.450 tons	$27,825	8,298 tons	$43,192	$15,367+
Brick and tile		5,704.393		5,570,875	133,518—
Cement	6,709,160 bbls.	14,962,945	7,404,221 bbls.	18,072,120	3,109,175+
Chromite	1,770 tons	43.031	347 tons	6,870	36.161—
Granite		495.732		725,901	230,169+
Lime	463,144 bbls.	557.232	463.534 bbls.	610,619	53,387+
Magnesite	83.695 tons	1,033,491	47.837 tons	511,102	522.389—
Marble	29,531 cu. ft.	92,899	30,232 cu. ft.	98,395	5,496+
Onyx			2,569 cu. ft.	1,294	1,294+
Sandstone	10,500 cu. ft.	2,300	10,150 cu. ft.	2,112	188—
Miscellaneous stone		6,803,557		7,834,640	1,031,083+
Total value		$29,723,405		$33,477,120	
Net increase					$3,753,715+

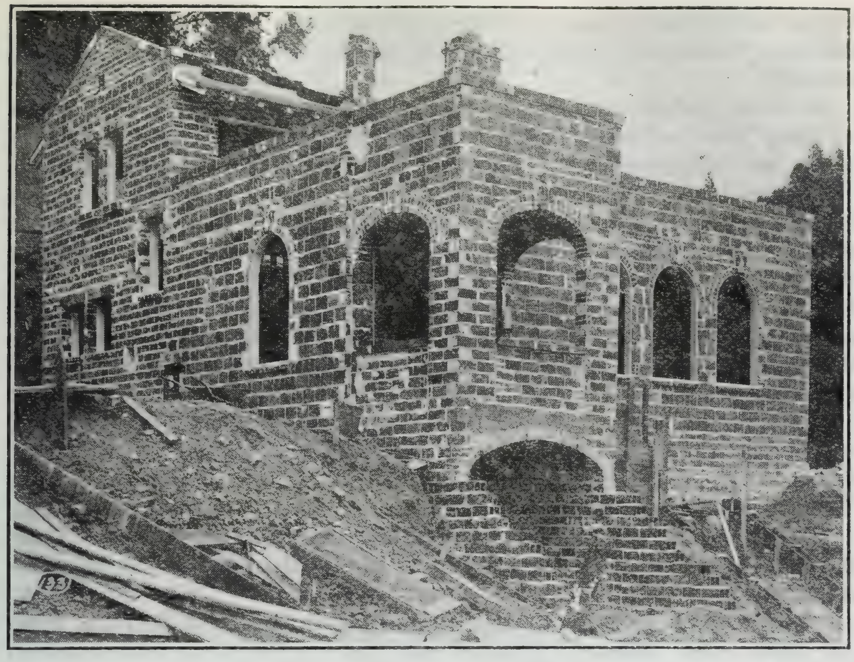
ASPHALT (see July bulletin).

BITUMINOUS ROCK (see July bulletin).

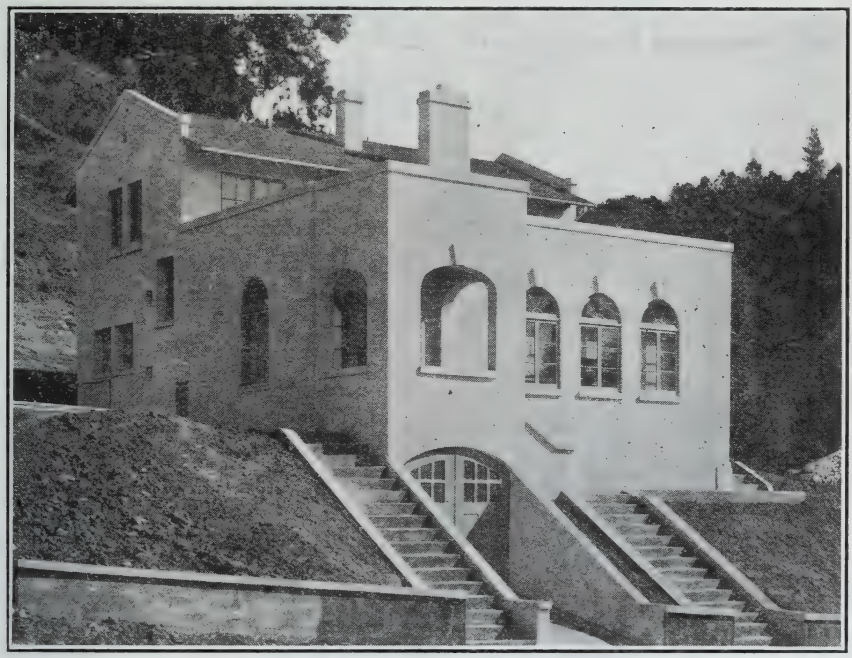
BRICK and TILE.

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII. Bulletin 38. Preliminary Report, No. 7.

As would be expected in a state with diversified and widespread mineral resources, bricks of many varieties and in important quantities are annually produced in California. The varieties include common,



Residence in Piedmont, Alameda County, showing construction with hollow building tile ("Dickey Mastertile"), made by the California Brick Company, Niles, California.



Residence in Piedmont (same as in preceding photograph), showing finished appearance of tile construction. Photos by courtesy of the California Brick Company.

fire, pressed, glazed, fancy, vitrified, and others. So far as possible the different kinds have been segregated in the tabulation accompanying herewith.

We also include under this heading the various forms of hollow building 'tile' or blocks, instead of under 'industrial' pottery clays as in the statistical reports previous to 1915. The application of these tile to residence construction is illustrated by the photographs reproduced herewith. As noted in a previous report,[1] they have been so utilized in residences in the southern part of the state for a number of years, but are now coming into vogue in northern California. The first cost is stated to be but slightly more than for a frame residence, and the tile have the advantage of permanency, requiring a minimum of repairs, being also fireproof, and keep a house warmer in winter and cooler in summer.

The clay industries throughout the country were adversely affected by the war-time restrictions on building operations, and particularly during 1918 by a 50% cut in their fuel and power allowances by the Federal Fuel Administrator. That they have recovered from that condition, is shown by comparison of the 1919-1921 figures with those of previous years. The total value of the 1920 product was considerably more than the previous record figure of the year 1907. The aggregate value for all kinds of brick in 1921 shows a slight decrease from the 1920 total. Glazed, pressed, and fancy varieties, also common brick, showed increases; but fire-brick and building blocks decreased.

The detailed figures of brick and tile production for 1921, by counties, are given in the following tabulation:

---

[1] State Mineralogist Report XV, p. 497, 1916.

Brick and Tile Production for 1921, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified paving		Hollow building tile or blocks		Total value
	Amount, M	Value	Amount, M	Value	Amount, M	Value	Tons	Value	
Alameda	4,701	$70,093	1,776	$126,533	1,495	$58,570			$255,196
Contra Costa	4,281	78,731							78,731
Fresno	7,905	114,187					680	$8,113	122,300
Imperial	654	6,363							6,363
Kern	5,840	85,820							85,820
Los Angeles	141,947	1,985,095	8,965	463,211	7,688	454,222	26,889	305,920	3,208,448
Orange	2,994	47,720							47,720
Riverside			3,930	167,912					167,912
Santa Clara	7,501	110,961							110,961
Humboldt, Marin, Mendocino, Riverside, Sacramento, San Diego, San Joaquin, San Mateo, Siskiyou, Tehama, Tulare, Ventura*	26,594	381,154							
Amador, Contra Costa, Fresno, Placer, San Joaquin, Ventura*			6,901	428,994					
Contra Costa, Fresno, Placer, Riverside, Sacramento, Ventura*					4,850	226,273			
Alameda, Contra Costa, Placer, Riverside, Sacramento, San Diego*							39,531	451,003	1,487,424
Totals	202,417	$2,880,124	21,572	$1,186,650	14,033	$739,065	67,100	$765,036	$5,570,875

*Combined to conceal output of a single operator in each.

Brick and Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for building tile being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Brick, M	Building blocks, tons	Value
1893	103,900		$801,750
1894	81,675		457,125
1895	131,772		672,360
1896	24,000		524,740
1897	97,468		563,240
1898	100,102		571,362
1899	125,950		754,730
1900	137,191		905,210
1901	130,766		860,488
1902	169,851		1,306,215
1903	214,403		1,999,546
1904	281,750		1,994,740
1905	286,618		2,273,786
1906	277,762		2,538,848
1907	362,167		3,438,951
1908	332,872		2,506,495
1909	333,846		3,059,929
1910	340,883		2,934,731
1911	327,474		2,638,121
1912	337,233		2,940,290
1913	358,754		2,915,350
1914	270,791		2,288,227
1915	180,538		1,678,756
1916	206,960		2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
Totals	6,183,561	266,500	$61,980,097

CEMENT (see June bulletin).

CHROMITE (see June bulletin).

GRANITE.

Bibliography: State Mineralogist Reports X, XII, XVII (inc.). Bulletin 38.

In the statistical reports of the State Mining Bureau for several years previous to 1916, granite was recorded as a subdivision under 'Stone Industry' or under 'Miscellaneous Stone.' Since 1916, we have given it a separate heading, as has always been done with marble and sandstone. Crushed rock, rubble, and paving blocks derived from granite quarries are continued under the heading of 'Miscellaneous Stone.'

The value of the granite output for 1921 was the highest of any year since 1892 with the exception of the year 1913. This is in part due

Granite Production by Counties, for 1921.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			7,800	$28,050	160	$560			$28,610
Madera	63,261	$418,043	11,999	37,444	53	168	6,000	$6,167	461,822
Placer	3,527	21,670	3,938	19,972	333	333	4,057	6,353	48,328
Riverside	1,900	3,350	3,700	8,250	75	102	2,150	1,150	12,852
Sacramento	6,121	20,783	250	500			6,382	18,186	39,469
San Diego			5,848	17,544					17,544
Inyo[1] and San Diego*	100,650	31,900							31,900
Nevada, Plumas, Tulare, Tuolumne*			9,245	40,376					40,376
San Bernardino[2] and San Diego*							86,000	45,000	45,000
Totals	175,459	$495,746	42,780	$152,136	621	$1,163	104,589	$76,856	$725,901

*Combined to conceal output of a single operator in each.

[1] Includes various rocks utilized for building stone, but not specified as to kind.

[2] Includes 'fire-stone' (granite) used for cement kiln liners.

to the resumption of building construction following the war-time curtailment, and in part due to the higher unit prices received for the 1921 product. Among the new buildings finished with granite, last year, should be mentioned the Bank of Italy in San Francisco, at the corner of Powell, Market and Eddy streets.

In so far as it has been possible to do so, granite production has been segregated in the preceding table into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at

Carved vase and plaque of 'silver-gray' granite from Lakeside Quarry, San Diego County, California. (See text.)

Raymond, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, the McGilvray-Raymond Granite Company of San Francisco has recently taken over and enlarged operations at the quarry formerly worked by the Simpson-Pirnie Company. This is a fine-grained, 'silver-gray' granite of uniform texture and color, especially suited for monumental and ornamental work. A beautifully carved and polished vase and plaque executed from this stone by Mr. Walter Ghetti of the Western Granite Company, San José, is illustrated herewith. It was loaned to the State Mining Bureau recently for exhibit purposes (see page 278, *ante*).

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County.

Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1906	$344,083
1888	57,000	1907	373,376
1889	1,329,018	1908	512,923
1890	1,200,000	1909	376,834
1891	1,300,000	1910	417,898
1892	1,000,000	1911	355,742
1893	531,322	1912	362,975
1894	228,816	1913	981,277
1895	224,329	1914	628,786
1896	201,004	1915	227,928
1897	188,024	1916	535,339
1898	147,732	1917	221,997
1899	141,070	1918	139,861
1900	295,772	1919	220,743
1901	519,285	1920	495,732
1902	255,239	1921	725,901
1903	678,670		
1904	467,472	Total	$16,189,985
1905	353,837		

LIME (see July bulletin).

MAGNESITE (see April bulletin).

MARBLE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII. Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. During 1921, production from one operator each in Inyo and San Diego counties, and two in Tuolumne, amounted to 30,232 cubic feet, valued at $98,395, being a slight increase both in quantity and value over the 1920 figures. This is still below what might be considered the normal output of earlier years, and certainly far below our possibilities.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amount were preserved.

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1906	31,400	$75,800
1888		5,000	1907	37,512	118,066
1889		87,030	1908	18.653	47.665
1890		80,000	1909	79,600	238,400
1891		100.000	1910	18,960	50,200
1892		115,000	1911	20,201	54,103
1893		40,000	1912	27,820	74,120
1894	38,441	98,326	1913	41,654	113,282
1895	14,864	56,566	1914	25.436	48.832
1896	7,889	32,415	1915	22,186	41,518
1897	4,102	7,280	1916	25,954	50,280
1898	8,050	23,594	1917	24,755	62,950
1899	9,682	10,550	1918	[a]17,428	49,898
1900	4,103	5,891	1919	25,020	74,482
1901	2,945	4,630	1920	[b]29,531	92,899
1902	19,305	37,616	1921	30,232	98,395
1903	84,624	97,354			
1904	55,401	94,208	Total value		$2,320,800
1905	73,303	129,450			

[a] Includes onyx and serpentine.
[b] Includes onyx.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII–XV (inc.). Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. As there was but a single operator, the Tolenas Springs quarry, Solano County, in 1918 and 1920, the figures for those years were combined with those of the marble output. In 1921, there were two operators in Solano County and one in Mono, and a total of 2569 cubic feet, valued at $1,294, was shipped. In the latter county, the travertine deposits near Bridgeport are being reopened, after an idleness of some years, by the Dineen Marble Company of Oakland. Operations are also reported under way at Kernville in Kern County.

Onyx Production of California, by Years.

Production by years was as follows:

Year	Value	Year	Value
1887	$900	1895	$12,000
1888	900	1896	24,000
1889	900	1918	*
1890	1,500	1919	*
1891	2,400	1920	
1892	1,800	1921	1,294
1893	27,000		
1894	20,000	Total	$92,694

*See under Marble.

SANDSTONE.

Bibliography: State Mineralogist Reports XII–XV, XVII. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1921 two counties—Santa Barbara and Ventura—turned out 10,150 cubic feet, valued at $2,112; compared with 10,500 cubic feet and $2,300 in 1920. This is considerably less than former years. The main feature of the loss since 1914 is the closing of the well-known Colusa quarries, on account of the competition of lighter-colored materials.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1906	182,076	$164,068
1888		150,000	1907	159,573	148,148
1889		175,598	1908	93,301	55,151
1890		100,000	1909	79,240	37,032
1891		100,000	1910	165,971	80,443
1892		50,000	1911	255,313	127,314
1893		26,314	1912	66,487	22,574
1894		113,592	1913	62,227	27,870
1895		35,373	1914	111,691	45,322
1896		28,379	1915	63,350	8,438
1897		24,086	1916	17,270	10,271
1898		46,384	1917	31,090	7,074
1899	56,264	103,384	1918	900	400
1900	378,468	254,140	1919	5,400	3,720
1901	266,741	192,132	1920	10,500	2,300
1902	212,123	142,506	1921	10,150	2,112
1903	353,002	585,309			
1904	363,487	567,181	Total value		$4,094,883
1905	302,813	483,268			

SERPENTINE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905	----------	----------
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[1]	[1]
1900	350	2,000	1918	[2]	[2]
1901	89	890	1919	----------	----------
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[1] Under 'Unapportioned.'
[2] See under Marble.

SLATE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but there has been none since, except in 1915, and a small amount in 1920. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.

> [1]"In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

---

[1] Bowles, O., Slate as a permanent roofing material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

In California, at present, the outlook is for some commercial output in 1922. The Losh quarry near Placerville, El Dorado County, was opened up in 1921, and some material prepared for market during the course of development work but not sold. The Pacific quarry at Hornitos, Mariposa County, is also being reopened.

Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1904	6,000	$50,000
1890	4,000	24,000	1905	4,000	40,000
1891	4,000	24,000	1906	10,000	100,000
1892	3,500	21,000	1907	7,000	60,000
1893	3,000	21,000	1908	6,000	60,000
1894	1,800	11,700	1909	6,961	45,660
1895	1,350	9,450	1910	1,000	8,000
1896	500	2,500	1911	--------	--------
1897	400	2,800	1915	1,000	5,000
1898	400	2,800	1916	--------	--------
1899	810	5,900	1920	8	80
1900	3,500	26,250	1921	--------	--------
1901	5,100	38,250			
1902	4,000	30,000	Totals	88,829	$676,479
1903	10,000	70,000			

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII–XVII. Bulletin 38.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer. Thus it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. In so far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept. Estimates have been made for some of this output, based on the mileage of roads repaired.

For the year 1921 miscellaneous stone shows an increase both in total tonnage and value over the preceding year, being $7,834,640 as compared with $6,803,557 in 1920. No doubt the increase would have been even greater both in this item and in cement, brick and other clay products, had it not been for the strike of the building trades in the San Francisco Bay district in the spring and summer of 1921. In addition to building work in the cities, construction on several hydroelectric power installations have been important factors contributing to the increase. Of these, mention should be made of the Pit River project of the Pacific Gas and Electric Company, the Hetch Hetchy dam of San Francisco on the Tuolumne River, and the Scott dam of the Snow Mountain Water and Power Company in Gravelly Valley, Lake County. The Dom Pedro dam of the combined Modesto-Turlock irrigation districts is also an important piece of work. Highway construction continues to utilize large tonnages of rock, gravel, and cement throughout the state.

In 1921, as has been the case for some years past, Los Angeles County led all others by a wide margin, with an output valued at $1,763,180; followed by Alameda, second, with $513,641; Fresno, third, $486,057; Riverside, fourth, $431,671; Contra Costa, fifth, $415,127; and Sacramento, sixth, $386,911.

Paving Blocks.

The paving block industry has decreased materially of recent years, almost to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Placer, Riverside, San Bernardino, and San Diego are of granite.

Production in 1921 amounted to only 4 M., valued at $280.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1906	4,203	$173,432
1888	10,500	367,500	1907	4,604	199,347
1889	7,303	297,236	1908	7,660	334,780
1890	7,000	245,000	1909	4,503	199,803
1891	5.000	150.000	1910	4,434	198,916
1892	*3,000	96,000	1911	4,141	210,819
1893	2,770	96,950	1912	11,018	578,355
1894	2,517	66,981	1913	6,364	363,505
1895	2,332	73,338	1914	6,053	270,598
1896	4.161	77,584	1915	3,285	171,092
1897	1,711	35,235	1916	1,322	54,362
1898	1,144	21,725	1917	938	38,567
1899	305	7,861	1918	372	17,000
1900	1,192	23,775	1919	27	1,350
1901	1,920	41,075	1920	63	3,155
1902	3,502	112.437	1921	4	280
1903	4,854	134,642			
1904	3,977	161,752	Totals	135,577	$5,308,799
1905	3,408	134,347			

*Figures for 1887–1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, there was a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold-dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, took place in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which come from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly basalt and diabase, with an occasional felsite and flint pebble. There is a tough black basalt which is stated to give satisfactory results. In Fresno County pebbles have been selected from the gravel beds of the San Joaquin River near Friant. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

There was some resumption of imports in 1919, amounting to 17,677 long tons, valued at $250,096, increasing to 23,782 tons and $338,630 in 1920; but dropping to 9,004 tons and $116,157 in 1921. California output for 1921 was 247 tons, valued at $1,418, all from San Diego County.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
Totals	55,608	$230,861

Sand and Gravel.

The distribution of the 1921 output of sand and gravel, by counties, is given in the following table:

County	Tons	Value	County	Tons	Value
Alameda	[a]357,232	$207,856	Riverside	19,722	$15,633
Alpine	200	150	Sacramento	[a]159,216	73,070
Butte	119,052	38,100	San Diego	[a]125,522	137,014
Calaveras	10,953	8,215	San Joaquin	149,361	67,415
Colusa	53,333	80,000	San Mateo	15,205	10,354
Contra Costa	[b]42,577	20,232	Santa Barbara	50,000	53,800
Del Norte	5,000	2,500	Santa Clara	122,350	98,584
El Dorado	2,600	1,250	Santa Cruz	17,000	8,700
Fresno	672,976	343,107	Shasta	14,000	8,000
Glenn	200,916	103,197	Sierra	1,240	858
Humboldt	81,563	80,688	Siskiyou	46,798	18,810
Imperial	375,240	65,967	Solano	8,000	3,400
Inyo	6,627	4,000	Sonoma	110,133	95,009
Lake	161,809	146,508	Stanislaus	167,267	157,214
Los Angeles	1,810,188	1,070,940	Tehama	18,683	14,750
Marin	28,667	14,333	Tulare	524,111	254,457
Mariposa	500	200	Tuolumne	69,840	76,850
Mendocino	29,000	17,500	Yolo	22,673	14,829
Merced	37,000	21,300	Yuba	133,285	73,387
Modoc	633	350	Kern, Lassen, Plumas, San Benito, Trinity, Ventura*	45,898	19,169
Monterey	[c]109,173	59,316			
Napa	127,902	67,405	Totals	6,174,581	$3,631,538
Nevada	9,833	3,820			
Orange	[d]107,133	68,801			
Placer	[a]4,170	4,500			

*Combined to conceal output of a single operator in each.

[a] Includes molding sand.

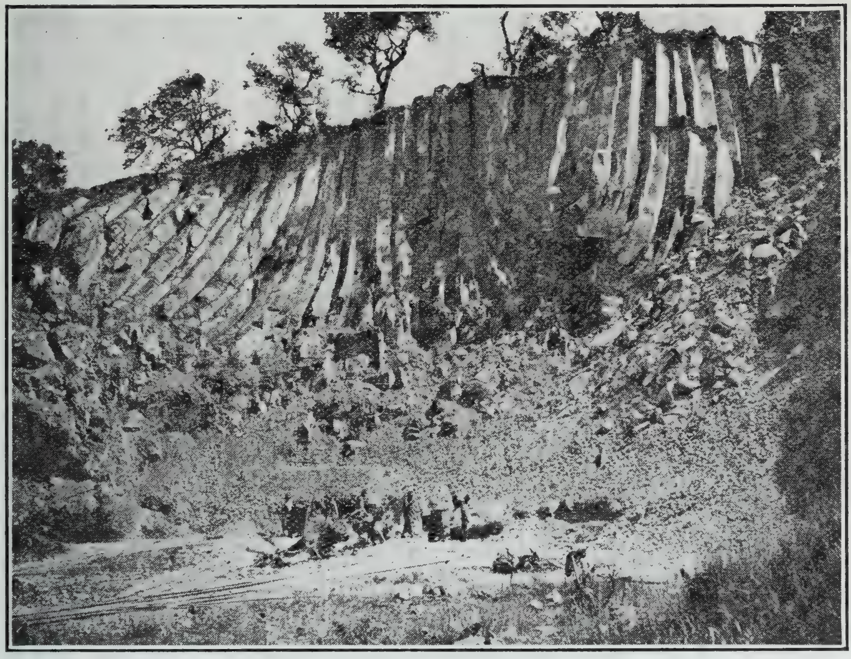
[b] Includes sand used for asphalt mix.

[c] Includes molding, building, blast, filter, and roofing sand, mainly from ocean beaches.

[d] Includes beach sand.

Crushed Rock.

To list the kinds and varieties of rocks utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis for like operations.



Stony Point Quarry of Petaluma and Santa Rosa Electric Railway Company, near Roblar, Sonoma County, California. Rock is trachytic tuff, used for ballast and macadam. An excellent example of columnar structure.

Crushed Rock Production, by Counties, for 1921.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	179,428	$128,448	2,000	$533	103,464	$105,374	[a]64,450	$71,430	349,342	$305,785
Alpine	1,500	700			100	75			1,600	775
Amador	2,500	1,125							2,500	1,125
Butte	238,366	165,800							238,366	165,800
Calaveras							[b]3,552	9,312	3,552	9,312
Contra Costa	25,613	33,507	572	536	36,276	40,810	357,388	320,042	419,849	394,895
Del Norte	5,000	3,000					100	80	5,100	3,080
El Dorado	1,500	1,500							1,500	1,500
Fresno	2,700	1,350					236,000	141,600	238,700	142,950
Humboldt	7,000	21,000	50,000	30,000					57,000	51,000
Imperial	21,333	44,000	116,472	26,206	36,700	35,000			174,505	105,206
Lassen	29,925	39,433			1,733	975			31,658	40,408
Los Angeles	33,333	36,000	71,451	114,322	244,591	263,092	451,376	278,326	800,751	692,240
Madera			8,747	4,765					8,747	4,765
Merced	6,000	6,000			7,000	3,000			13,000	9,000
Modoc	28,000	31,500			1,466	3,080			29,466	34,580
Napa	10,286	19,488			13,653	20,871	1,893	3,336	25,832	43,695
Nevada	22,260	15,280							22,260	15,280
Orange					59,999	62,500			59,999	62,500
Placer	11,017	9,500	11,806	7,490					22,823	16,990
Riverside	103,000	102,000	73,000	60,500	238,694	238,858	[c]1,500	14,400	416,194	415,758
Sacramento	386,091	308,000	7,485	5,841					393,576	313,841
San Bernardino	108,061	57,438	70,290	70,290	4,434	4,877	24,466	12,967	207,251	145,572
San Francisco	30,253	41,562							30,253	41,562
San Luis Obispo					52,000	80,000			52,000	80,000
San Mateo	15,402	21,100	324	364	15,039	22,558	7,152	7,321	37,917	51,343
Santa Barbara	8,800	11,800							8,800	11,800
Santa Clara	30,000	23,000			15,000	17,000			45,000	40,000

Santa Cruz	3,000	2,000	----------	----------	6,627	12,131	51	64	9,678	14,195
Shasta	36,973	21,545	----------	----------	4,133	2,400	----------	----------	41,106	23,945
Siskiyou	[d]40,522	25,533	----------	----------	----------	----------	----------	----------	40,522	25,533
Sonoma	13,232	11,169	255	191	642	482	45,989	44,449	60,118	56,291
Tulare	15,000	25,500	2,303	2,015	2,150	2,150	----------	----------	19,453	29,665
Tuolumne	3,170	2,335	----------	----------	133,000	150,000	----------	----------	136,170	152,335
Inyo, Kern, Mariposa, Mendocino, Plumas, San Benito, Sierra, Solano, Tehama, Trinity, Ventura*	427,085	355,750	----------	----------	----------	----------	----------	----------	----------	----------
Lassen and Marin*	----------	----------	12,400	18,150	----------	----------	----------	----------	----------	----------
Inyo, Marin, Monterey, San Diego, San Joaquin, Tehama*	----------	----------	----------	----------	214,804	237,890	----------	----------	----------	----------
Inyo, Monterey, Nevada, San Diego,[c] Solano, Stanislaus, Ventura*	----------	----------	----------	----------	----------	----------	80,690	86,888	734,979	698,678
Totals	1,846,350	$1,566,363	427,105	$341,203	1,191,505	$1,303,123	1,274,607	$990,715	4,739,567	$4,201,404

---

*Combined to conceal output of a single operator in each.

[a] Includes red shale for roofing.

[b] Includes 'greenstone' (amphibolite) schist for roofing.

[c] Includes roofing granules.

[d] Includes volcanic 'cinders' (pumice) used for railroad ballast

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1909	5,531,561	$2,708,326
1894	661,900	664,838	1910	5,827,828	2,777,690
1895	1,254,688	1,095,939	1911	6,487,223	3,610,357
1896	960,619	839,884	1912	8,044,937	4,532,598
1897	821,123	600,112	1913	9,817,616	4,823,056
1898	1,177,365	814,477	1914	9,288,397	3,960,973
1899	964,898	786,892	1915	10,879,497	4,609,278
1900	789,287	561,642	1916	9,951,089	4,009,590
1901	530,396	641,037	1917	8,069,271	3,505,662
1902	2,056,015	1,249,529	1918	6,641,144	3,325,889
1903	2,215,625	1,673,591	1919	6,919,188	3,678,322
1904	2,296,898	1,641,877	1920	9,792,122	6,782,414
1905	2,624,257	1,716,770	1921	10,914,145	7,834,640
1906	1,555,372	1,418,406			
1907	2,288,888	1,915,015	Totals	132,731,394	$75,476,653
1908	3,998,945	3,241,774			

A comparison of the above table of annual productions of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

SECTION FIVE —— INDUSTRIAL MATERIALS.

Bibliography: Reports XIV, XV. Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of Industrial Materials, as distinguished from those which have a clearly defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely varying amounts of a certain material produced from year to year, but in widely varying prices of the same material. Furthermore, the quality of this general class of material will be found to fluctuate, even in the same deposit. The war in Europe affected some of these items, but not to the striking degree that it did the metal markets.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrite, pottery clays, diatomaceous earth, and dolomite.

This group as a whole showed a decrease in the total value from $3,583,100 for 1920 to $2,675,438 in 1921, a difference of nearly a million dollars. The principal losses were by diatomaceous earth, talc, pottery clay, pyrites, mineral water, and dolomite.

The following summary shows the value of the industrial material produced in California during the years 1920–1921, with increase or decrease in each instance:

Substance	1920		1921		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	66 tons	$2,740	410 tons	$19,275	$16,535+
Barytes	3,029 tons	20,795	901 tons	4,809	15,986—
Clay (pottery)	203,997 tons	440,689	225,120 tons	362,172	78,517—
Dolomite	42,388 tons	132,791	31,195 tons	99,155	33,636—
Feldspar	4,518 tons	26,189	4,349 tons	28,343	2,154+
Fuller's earth	600 tons	6.000	1,185 tons	8,295	2,295+
Gems		36,056		10,954	25,102—
Graphite	*	*	*	*	* —
Gypsum	20,507 tons	92,535	37,412 tons	78,875	13.660—
Infusorial and diatomaceous earths	60,764 tons	1,056.260	*	*	* —
Limestone	90,120 tons	298,197	75,921 tons	305,912	7,715+
Lithia	10,046 tons	153,502	*	*	* —
Mineral paint	779 tons	8,477	446 tons	4,748	3,729—
Mineral water	2,391,791 gals.	421,643	3,446,278 gals.	367,476	54,167—
Pumice and volcanic ash	1,537 tons	25,890	406 tons	6,310	19.580—
Pyrites	146,001 tons	530,581	110,025 tons	473,735	56,846—
Silica (sand and quartz)	25,324 tons	96,793	10,569 tons	49,179	47,614—
Soapstone and talc	11,327 tons	221,362	8,752 tons	130,078	91.284—
Unapportioned[1]		12,600		726,122	496,140—
Total value		$3,583,100		$2,675,438	
Net decrease					$907,662—

*Combined under 'unapportioned.'

[1] In 1920 includes graphite and columbite (tantalum ore); in 1921 includes graphite, diatomaceous earth and lithia.

ASBESTOS (see April bulletin).

BARYTES (see April bulletin).

CLAY (pottery).

Bibliography: State Mineralogist Reports I, IV, IX, XII–XV, XVII. Bulletin 38. Preliminary Report, No. 7.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. In this report pottery clay refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form, or whether it was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated, paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

During 1921, a total of 36 producers in 12 counties reported an output of 225,120 short tons of pottery clays, having a total value of $362,172 f.o.b. rail-shipping point, for the crude material, as compared with the 1920 production of 203,997 tons worth $440,689.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1921, is shown herewith:

Pottery Clay in 1921.

County	Tons	Value	Used in the manufacture of—
Alameda	6,079	$7,405	Sewer and chimney pipe, drain tile, flue lining, et al.
Amador	22,124	46,664	Architectural terra cotta, porcelain, stoneware, fire-clay products and various.
Humboldt	75	190	Art pottery and drain tile.
Los Angeles	[b] [c]29,055	62,866	Architectural terra cotta, floor and roofing tile, sewer et al. pipe, conduit.
Placer	[d]76,665	95,930	Architectural terra cotta; drain, floor, mantel and roofing tile; chimney, flue and sewer pipe; garden furniture.
Riverside	[e]84,224	111,219	Architectural terra cotta, floor and faience tile, conduit, sewer pipe, chemical stoneware, and fire-clay products.
San Diego	440	2,600	Porcelain ware and various.
Santa Clara	1,126	2,300	Red earthenware and tile.
Contra Costa[a], Fresno[b], Orange, San Bernardino, San Joaquin, Ventura*	5,332	32,998	Terra cotta, drain tile, chinaware, and various.
Totals	225,120	$362,172	

*Combined to conceal output of a single operator in each.

[a] Includes shale.

[b] Includes crushed brick for roofing, et al.

[c] Includes kaolin used in a cleaning and polishing compound.

[d] Includes ground fire clay.

[e] Includes ball clay.

Haulage system in clay pit of Lincoln Clay Products Company, near Lincoln, Placer County, California.

Pottery Clay Products.

The values of the various pottery clay products made in California during 1921, totaled $5,478,848, compared with $3,923,518 in 1920, their distribution being shown in the following tabulation:

Values of Pottery Clay Products, 1921.

Product	No. of producers	Value
Architectural terra cotta	7	$1,477,948
Chimney pipe, terra cotta, and flue linings	2	97,822
Drain tile	10	79,394
Roofing tile	5	495,963
Sewer pipe	8	1,329,300
Stoneware, chemical and sanitary ware	9	1,226,727
Red earthenware	3	120,406
Floor, faience, glazed and hand-made tile	12	502,159
Miscellaneous, art pottery, terra cotta, garden furniture, mortar colors, vitrified conduit, bisque ware and doll heads	9	149,129
Total value		$5,478,848

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value
1887	75,000	$37,500
1888	75,000	37,500
1889	75,000	37,500
1890	100,000	50,000
1891	100,000	50,000
1892	100,000	50,000
1893	24,856	67,284
1894	28,475	35,073
1895	37,660	39,685
1896	41,907	62,900
1897	24,592	30,290
1898	28,947	33,747
1899	40,600	42,700
1900	59,636	60,956
1901	55,679	39,144
1902	67,933	74,163
1903	90,972	99,907
1904	84,149	81,952
1905	133,805	130,146
1906	167,267	$162,283
1907	160,385	254,454
1908	208,042	325,147
1909	299,424	465,647
1910	249,028	324,099
1911	224,576	252,759
1912	199,605	215,683
1913	231,179	261,273
1914	179,948	167,552
1915	157,866	133,724
1916	134,636	146,538
1917	166,298	154,602
1918	112,423	166,788
1919	135,708	245,019
1920	203,997	440,689
1921	225,120	362,172
Totals	4,299,713	$5,138,876

DOLOMITE (see July bulletin).

FELDSPAR (see July bulletin).

NOTE.—Value of the 1921 output as given on pages 328-329, *ante*, should be $28,343, instead of $28,333.

FLUORSPAR (see April bulletin).

FULLER'S EARTH (see July bulletin).

GEMS (see July bulletin).

GRAPHITE (see April bulletin).

GYPSUM (see July bulletin).

INFUSORIAL and DIATOMACEOUS EARTHS (see July bulletin).

LIMESTONE (see July bulletin).

LITHIA (see August bulletin).

MICA (see August bulletin).

MINERAL PAINT (see August bulletin).

MINERAL WATER (see August bulletin.)

PHOSPHATES (see August bulletin).

PUMICE and VOLCANIC ASH (see August bulletin).

PYRITES (see April bulletin).

SILICA (Sand and Quartz).

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII. Bulletins 38, 67.

We combine these materials, because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. Some also is utilized as a foundry flux, and for steel casting moulds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile; and some of the sand for the preparation of sodium silicate ('water glass').

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1921 amounted to 10,569 tons, valued at $49,179, from eleven properties in six counties, distributed as follows:

County	Tons	Value
Amador	1,802	$20,646
Riverside	1,625	6,357
San Diego	370	725
Kern, Monterey, Placer*	6,772	21,451
Totals	10,569	$49,179

*Combined to conceal output of a single operator in each.

Of the above total, 5,940 tons were of sand, and 4,629 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Monterey, Orange, Placer, Riverside, San Joaquin, and Tulare. The chief producing centers have been Amador, Monterey, and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1912	13,075	$15,404
1900	2,200	2,200	1913	18,618	21,899
1901	5,000	16,250	1914	28,538	22,688
1902	4,500	12,225	1915	28,904	34,322
1903	7,725	7,525	1916	20,880	48,908
1904	10,004	12,276	1917	19,376	41,166
1905	9,257	8,121	1918	23,257	88,930
1906	9,750	13,375	1919	18,659	101,600
1907	11,065	8,178	1920	25,324	96,793
1908	9,255	22,045	1921	10,569	49,179
1909	12,259	25,517			
1910	19,224	18,265	Totals	319,059	$679,038
1911	8,620	8,672			

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII. Bulletins 38, 67. U. S. Bur. of Mines, Rep. of Investigations, Serial No. 2253, May, 1921.

Talc—also called soapstone or steatite—occurs widely distributed throughout California. It is found as a hydration product in the alteration of magnesian silicates, and is often associated with serpentine and actinolite. A few deposits have been proven of especial value to date, and there is an undoubted future for this branch of the mineral industry in the state. Deposits of high-grade white talc, the equal of the imported Italian article, are being worked in Inyo and San Bernardino counties. It is used in making paper, rubber, toilet articles, soap, rice polishing, lubricants, tiling, as a paint filler, etc., and for such is ordinarily ground to about 200 mesh before marketing. In this condition it brings $15 per ton and upwards, depending on quality. Some of the Inyo talc is turned and bored to various shapes for electrical insulation in such appliances as coffee percolators, heaters, and the like.

Commercially, the higher grades are called talc, and the lower, soapstone. Soapstone blocks are used in fireless cookers, electric switchboards, laboratory table tops and laundry tubs; and the crushed material is used in roofing papers.

There was a total output in 1921 of 8,752 tons, valued at $130,078, from two producers each, in El Dorado, Inyo, and San Bernardino counties. This is a decrease both in tonnage and value from the 1920 figures of 11,327 tons and $221,362, due largely to the competition of foreign imports.

The 1921 output was distributed by counties, as follows:

County	Tons	Value
El Dorado	1,652	$9,453
Inyo	4,350	77,250
San Bernardino	2,750	43,375
Totals	8,752	$130,078

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. A small, irregular production of white talc was obtained from certain eastern states, but the material fluctuated in quality and quantity to such an extent that it was not largely used by manufacturers of the better-grade toilet powders. Gradually a wall of prejudice against all domestic talcs grew up in the trade, and this has been fostered by people interested in the sale of the imported article.

Deposits of high-grade talc in California have been known for several years, but little interest was shown in them until 1911-1912. The lack of importations during 1917–1919, gave California an opportunity to demonstrate the quality of her goods. According to Ladoo:[1]

> "In the essential qualities of pure white color, freedom from grit, and fine-grain size it is a well-established fact that the best California talcs equal or surpass the best imported talcs. In the debatable qualities of slip and freedom from lime some of the best California talcs equal some of the best imported talcs and in other cases excel other imported talcs. Some of the very largest consumers of toilet-grade talc have expressed complete satisfaction with the high-grade California talcs and have used them regularly in preference to Italian talc.
>
> "Therefore, it can not be truthfully said that the United States produces no talcs equal in quality to imported talcs. Unfortunately many domestic consumers have been so thoroughly imbued with the alleged superiority of imported talcs that domestic talcs have not been given a fair chance. It is even reported that unscrupulous dealers have relabeled domestic talc and sold it as Italian talc, with perfect satisfaction to the consumers. Such dishonest trade practices are probably not common, but they serve to refute the erroneous statments regarding the quality of domestic talc."

Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, the California operators are up against high transcontinental freight rates. In 1921 imports amounted to 11,456 tons of ground talc, valued at $238,581.

It is stated that in Italy the mines are all small tunnel workings, operated in the main by people of limited capital. Few of the companies have their own mills, the mills being separate enterprises, located at a central point, to which all the lump talc is hauled by teams. Practically all of these mines are in the northwestern corner of Italy, in the district of Pinerolo (Val Chisone), near Turin (Torino), in the province of Piedmont.

Talc Production of California, by Years.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1909	33	$280
1894			1910	740	7,260
1895	25	375	1911		
1896			1912	1,750	7,350
1897			1913	1,350	6,150
1898			1914	1,000	4,500
1899			1915	1,663	14,750
1900			1916	1,703	9,831
1901	10	119	1917	5,267	45,279
1902	14	288	1918	11,760	85,534
1903	219	10,124	1919	8,764	115,091
1904	228	2,315	1920	11,327	221,362
1905	300	3,000	1921	8,752	130,078
1906					
1907			Totals	55,308	$681,484
1908	3	48			

---

[1] Ladoo, R. B., High-grade talc and the California talc industry: U. S. Bur. of M., Reports of Investigations, Serial No. 2253, May, 1921.

STRONTIUM.

Bibliography: Bulletin 67. U. S. G. S., Bull. 540; 660-I.

There was no production of strontium minerals in California in 1919–1921, though in 1918 both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the first considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. Specimens from this deposit have been received and identified at the laboratory of the State Mining Bureau.

In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped. The above noted output was converted to the nitrate.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919	----------	----------
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. Previous to 1914, the nitrate was imported from Germany, England, and Sicily. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67.

There has not been, for many years, any commercial output of native sulphur in California, although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Mariposa, San Bernardino, Shasta, Sonoma, Tehama, and Ventura counties. Operations were begun late in 1917, on a property in Inyo County, and some material stated to assay 40% sulphur was mined. Difficulties were encountered in refining it, so that only a small production was made, but none shipped.

At the Elgin mine, near Wilbur Springs, in Colusa County, a small tonnage of sulphur was prepared toward the close of 1918, but not shipped. The ore body is stated to assay 52.6% S. over a width of 22 feet. Two retorts, steam-heated, were installed, with a capacity of 4500 pounds of ore, each, per charge. There is a large body of material, in a zone at least 75 feet wide, impregnated with native sulphur crystals, which can be cheaply mined, if certain mechanical difficulties of melting and cleaning can be economically overcome.

Sulphur was produced at the famous Sulphur Bank mine, in Lake County, during the years 1865–1868 (inc.) totaling 941 tons, valued at $53,500; following which the property became more valuable for its quicksilver. The Elgin mine, noted above, is a similar occurrence.

There are prospects for some production for 1922, as a plant has been built by the California Sulphur Company, to handle material from a deposit near Maricopa in Kern County. The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that the three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1921, a total of 285,762 long tons valued at $4,524,788 was exported, with only 4 tons worth $226 imported into the United States.

SECTION SIX —— SALINES.

Bibliography: State Mineralogist Reports XIV, XV, XVII. Bulletin 24.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have only recently been added to the commercial list, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, San Luis Obispo, and Siskiyou counties, and the waters of the Pacific Ocean.

The following tabulation shows amount and value of the saline minerals produced in California during the years 1920 and 1921, with increase or decrease in value for 1921, as compared with the previous year:

Substance	1920		1921		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borax	127,065	$2,794,206	50,136	$1,096,326	$1,697,880—
Calcium chloride			683	22,980	22,980+
Magnesium salts	3,150	107,787	4,153	106,140	1,647—
Potash	26,298	1,465,463	14,806	390,210	1,075,253—
Salt	230,638	972,648	197,989	832,702	139,946—
Soda	32,407	1,164,898	14,828	438,996	725,902—
Total value		$6,505,002		$2,887,354	
Net decrease					$3,617,648—

BORAX (see June bulletin).

CALCIUM CHLORIDE.

Calcium chloride ($CaCl_2$) was reported for the first time to the State Mining Bureau as produced commercially, in 1921, from plants in San Bernardino County. It is obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes. The total for 1921 amounted to 683 tons, valued at $22,980.

Calcium choride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

MAGNESIUM SALTS (see August bulletin).

NITRATES (see August bulletin).

POTASH (see August bulletin).

SALT.

Bibliography: State Mineralogist Reports II, XII, XV, XVII. Bulletin 24.

Most of the salt produced in California is obtained by evaporating the waters of the Pacific Ocean, plants being located on the shores of San Francisco Bay, Monterey Bay, Long Beach, and San Diego Bay. Additional amounts are derived from lakes and lake beds in the desert regions of the state. The salt production of San Bernardino County is mainly derived from deposits of rock salt which are worked by means of quarrying and steam shovels. A small amount of valuable medicinal salts is occasionally obtained in Mono and Tehama counties, by evaporation from Mono Lake and mineral springs respectively.

Formerly a considerable proportion of the table salt consumed in California was shipped in from Eastern points; but, at present, California salt refineries supply not only our own needs but export a fair tonnage to other markets.

It may appear at first thought superfluous to enumerate the uses of so well-known an item as 'common' salt, one whose history antedates the written page; but it is employed for many purposes other than culinary. A bulletin of the U. S. Geological Survey states that there was produced in the United States in 1920 sufficient salt to supply each one of the 106,000,000 inhabitants with 150 pounds apiece. Besides its culinary uses, salt is employed in packing meat, curing fish and hides, dairying, refrigerating, preserving products from deterioration, pottery glazing, enameling, pickle making, salting live stock, and in some chemical industries, as in preparing soda ash and caustic soda.

Distribution of the 1921 salt production of California, by counties, was as follows:

County	Tons	Value
Alameda	108,925	$370,296
Kern	18,500	93,500
San Bernardino	13,279	67,782
San Mateo	32,587	167,022
Los Angeles, Mono[a], Modoc, Monterey, San Diego*	24,698	134,102
Totals	197,989	$832,702

[a] Medicinal salts.
*Combined to conceal output of a single operator in each.

The above returns show decreases both in tonnage and value from the 1920 figures of 230,638 tons and $972,648. In 1921 there were 8 plants operating in Alameda, and a total of 13 plants in the other counties tabulated.

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1906	101,650	$213,228
1888	30,800	92,400	1907	88,063	310,967
1889	21,000	63,000	1908	121,764	281,469
1890	8,729	57,085	1909	155,680	414,708
1891	20,094	90,303	1910	174,920	395,417
1892	23,570	104,788	1911	173,332	324,255
1893	50,500	213,000	1912	185,721	383,370
1894	49,131	140,087	1913	204,407	462,681
1895	53,031	150,576	1914	223,806	583,553
1896	64,743	153,244	1915	169,028	368,737
1897	67,851	157,520	1916	186,148	455,695
1898	93,421	170,855	1917	227,825	584,373
1899	82,654	149,588	1918	212,076	806,328
1900	89,338	204,754	1919	233,994	896,963
1901	126,218	366,376	1920	230,638	972,648
1902	115,208	205,876	1921	197,989	832,702
1903	102,895	211,365			
1904	95,968	187,300	Totals	4,087,310	$11,259,136
1905	77,118	141,925			

SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII. Bulletins 24, 67.

The production of carbonates of sodium in California in 1920 included soda ash from plants at Owens Lake, Inyo County, and crude 'trona' from Searles Lake, San Bernardino County. There were no shipments in 1921 of sulphate from the deposit on Carrizo Plains, San Luis Obispo County. The total amounted to 14,828 tons, valued at $438,996, being less than one-half the record output of 1920 which was 32,407 tons worth $1,164,898, and the smallest yield of any year since 1916.

These 'sodas' produced in California have been used in the manufacture of glass, soap, and paper, as well as for washing and baking soda, in sugar refining, and in various chemical industries. The crude trona shipped in 1921 was used for neutralizing in flotation concentration in place of soda ash. For several years a portion of California's product was exported, but since the latter part of 1920, the export demand has fallen off.

The war stimulated the chemical industry in the United States to produce materials that were formerly imported and to supply them to foreign countries, as well as to devise new uses for chemical products, also to replace more expensive by less expensive chemicals. Sodium compounds replaced potassium compounds, either wholly or in part, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1909	7,712	$11,593
1895	1,900	47,500	1910	8,125	11,862
1896	3,000	65,000	1911	9,023	52,887
1897	5,000	110,000	1912	7,200	37,094
1898	7,000	154,000	1913	1,861	24,936
1899	10,000	250,000	1914	6,522	115,396
1900	1,000	50,000	1915	5,799	83,485
1901	8,000	400,000	1916	10,593	264,825
1902	7,000	50,000	1917	24,505	928,578
1903	18,000	27,000	1918	20,447	855,423
1904	12,000	18,000	1919	21,294	721,958
1905	15,000	22,500	1920	32,407	1,164,898
1906	12,000	18,000	1921	14,828	438,996
1907	----------	----------			
1908	9,600	14,400	Totals	281,346	$5,958,331

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as by those who utilize the facilities of the collection.

During the month a total of 535 visitors signed their names to the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

The number of new mineral species in California is slowly increasing as the state becomes more settled. Each year several are added to the list which, when first compiled in 1866, contained about seventy-five. At the present time the occurrence of over three hundred minerals is known; of this number more than fifty are of commercial importance.

During the thirty-day period covered by this report 285 samples were received and determined. From this number a list is appended, which, judging from the sample submitted only, may possibly be of commercial value if in sufficient quantity.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–258	Feldspar.
05–259	Copper ore; also kaolinite.
05–260	Kaolin-like mineral.
05–261	Highly kaolinized rock.
05–262	Gold ore.
05–263	Black sand containing gold and platinum group metals.
05–264	Sand containing gold and platinum.
05–265	Copper-gold ore.
05–266	Copper-gold ore.
05–267	Lead-silver ore.
05–268	Thenardite; good grade of sodium sulphate.
05–269	Sphalerite; some silver present.
05–270	Realgar (arsenic sulphide).
05–271	Gold ore; also impure talc.
05–272	Malachite; copper carbonate containing some gold and silver.
05–273	Malachite; some gold present.
05–274	Iron oxides and sulphides; small amount of platinum present.
05–275	Gold quartz.
05–276	Barite.
05–277	Silver-copper ore.
05–278	Limestone.
05–279	Gold ore; contains gold and silver.
05–280	Arsenopyrite.
05–281	Iron alum (coquimbite).
05–282	Sulphides of lead and silver with copper carbonate.

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey Bulletins:
- Bulletin 686-Z. Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma. By P. U. Roundy, K. C. Heald and G. B. Richardson.
- Bulletin 730-C. The Shapes of Pebbles. By Chester K. Wentworth.
- Bulletin 735-E. Primary Native Silver Ores near Wickenburg, Arizona. By E. S. Bastin.
- Bulletin 736-B. Oil and Gas Prospects in and near the Crow Indian Reservation, Montana. By W. T. Thom, Jr.
- Bulletin 707. Guide Book of the Western United States. Part E. The Denver and Rio Grande Western Route. By Marius R. Campbell.

U. S. Geological Survey Professional Papers:
- Professional Paper 131-A. Additions to the Flora of the Wilcox Group. By Edward Wilbur Berry.

U. S. Geological Survey Mineral Resources:
- Asphalt and Related Bitumens in 1921. By K. W. Cottrell.
- Magnesite in 1921. By Charles G. Yale.
- Tin in 1921. By Bertrand Leroy Johnson.
- Mica in 1921. By B. H. Stoddard.
- Talc and Soapstone in 1920. By Edward Sampson.
- Bauxite and Aluminum in 1921. By James M. Hill.
- Quicksilver in 1921. By F. L. Ransome, with a Supplementary Bibliography by Isabel P. Evans.
- Clay-working Industries, Clay and Silica Brick in 1919 and 1920. By Jefferson Middleton.
- Feldspar in 1921. By Frank J. Katz.

U. S. Bureau of Mines Technical Papers:
  No. 276. Safe Mechanical Equipment for Use in Shaft Sinking. By R. H. Kudlich.
  No. 277. Application of the Geophone to Mining Operations. by Alan Leighton.
  No. 307. Permissible Explosives, Mining Equipment, and Apparatus, Approved Prior to March 15, 1922. By S. P. Howell, L. C. Ilsley, D. J. Parker and A. C. Fieldner.
  No. 311. Factors in the Spontaneous Combustion of Coal. By O. P. Hood.

U. S. Bureau of Mines Reports of Investigations:
  Serial No. 2371. Why Miners' Portable Electric Lamps Require Safety Devices. By L. C. Ilsley, Electrical Engineer, U. S. Bureau of Mines.
  Serial No. 2372. Keeping up to Date in Safety Methods in Coal Mining. By D. Harrington, Supervising Mining Engineer, Bureau of Mines.
  Serial No. 2373. Fuel Economy from Old Plant Equipment. By A. R. Mumford, Assistant Fuel Engineer, U. S. Bureau of Mines.
  Serial No. 2374. Summary of Investigations of Dust and Ventilation in Metal Mines. By D. Harrington, Supervising Mining Engineer, U. S. Bureau of Mines.
  Serial No. 2375. Approval of Concordia Hand and Trip Lamp for Mines. By L. C. Ilsley, Electrical Engineer, U. S. Bureau of Mines.
  Serial No. 2376. Explosives Used in May, 1922. By W. W. Adams, Statistician, U. S. Bureau of Mines.
  Serial No. 2377. Storage and Transportation of Portland Cement. By W. M. Myers, Assistant Mineral Technologist, U. S. Bureau of Mines.
  Serial No. 2378. Determination of Suspended Matter in Gases by Collection on Filter Paper. By S. H. Katz, Assistant Physical Chemist, Pittsburgh Experiment Station, U. S. Bureau of Mines, and G. W. Smith, Junior Chemist, Pittsburgh Experiment Station, U. S. Bureau of Mines.
  Serial No. 2379. Fatalities at Coal Mines in June, 1922. By W. W. Adams, Statistician, Bureau of Mines.

U. S. Bureau of Standards Technologic Papers. No. 214. Durability of Cement Drain Tile and Concrete in Alkali Soils. Third Progress Report (1919–1920). By C. M. Williams, Associate Engineer.

U. S. Bureau of Standards Scientific Papers: No. 435. Metallographic Etching Reagents for Copper Alloys, Nickel and the Alpha Alloys of Nickel. By Henry S. Rawdon, Physicist, and Marjorie G. Lorentz, Assistant Physicist.

U. S. Bureau of Standards Circular No. 90. U. S. Government Specifications for Red Lead—Dry and Paste.

U. S. Department of Commerce—Bureau of the Census:
  Fourteenth Census of the United States. Mines and Quarries 1919. Petroleum and Natural Gas—Iron Ore.

U. S. Department of Commerce:
  Commerce Reports, August 14, 1922.
  Commerce Reports, September 4, 1922.
  Commerce Reports, September 11, 1922.
  Monthly Summary of Foreign Commerce of the U. S., Part II, June, 1922.

Smithsonian Institution, United States National Museum Bulletin 122. A Monograph of the American Shipworms. By Paul Bartsch.

Smithsonian Institution, United States National Museum. Contributions from the United States National Herbarium, Vol. 24, Part 2; Vol. 24, Part 4.

Florida State Geological Survey. Fourteenth Annuad Report.

Kentucky Geological Survey. Series VI. Oil Field Stratigraphy of Kentucky. by Willard Rence Jillson.

Scientific and Industrial Research Council of Alberta, Edmonton, Canada:
  Second Annual Report.
  First Annual Report on the Mineral Resources of Alberta. By John A. Allen.
  Second Annual Report on the Mineral Resources of Alberta, 1920. By John A. Allen.
  Third Annual Report on the Mineral Resources of Alberta—Geology of Drumheller Coal Field.

Canada Department of Mines. Geological Survey: Reports 1921. Parts A–D.

Memoir 131. No. 112 Geological Series; Kenogami, Round and Larder Lake Areas, Temiskaming District, Ontario. By H. C. Cooke.
New Zealand Department of Mines—Geological Survey Branch.
Palaeontological Bulletin No. 9. The Upper Cretaceous Gastropods of New Zealand, by Otto Wilckens, Ph.D.
Alphabetical List of New Zealand Tertiary Mollusca. By Henry Suter.
Transvaal Chamber of Mines. Monthly Analysis of Gold Production in the Transvaal, June, 1922.
Secretario De Industria, Commercio, Y. Trabajo, Instituto Geologico De Mexico. Boletin Num. 37 Estudio Geologico Minero de los Districtos De El Oro Y Tealpujahua.

Societies and Educational Institutions.

Colorado School of Mines: Alumni Magazine, Vol. 4, No. 2, Asbestos.
Pennsylvania State College, Mining Experiment Station of the School of Mines: Bulletin No. 1. An Investigation of the Properties of Smithing Coals. By H. J. Sloman.
University of Illinois: Illinois Athletics.
McGill University: Bulletin of General Information, 1922–23.
American Mineralogist—Journal of the Mineralogical Society of America. August, 1922.
Philippine Journal of Science. April, 1922.
Engineering Society of Western Pennsylvania. Proceedings February, March and April, 1922.
Mining and Metallurgical Society of America. June 1, 1922.
California Academy of Sciences. Proceedings. Fourth Series, Vol. XI, Nos. 18, 19, 20 and 21.

Books.

Material Handling Cyclopedia.
Engineering Index, 1921.

Maps.

Official Railroad Map of California. State Railroad Commission.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Brick and Clay Record, Chicago.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Hercules Mixer, Washington, Delaware.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oildom, New York.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.

Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport-Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Georgetown Gazette, Georgetown, Cal.
Gateway Gazette, Beaumont, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Humboldt Standard, Eureka, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oroville Daily Register, Oroville, Cal.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Petroleum Reporter, Etna Mills, Cal
Plumas National Bulletin, Quincy, Cal.
Plumas Independent, Quincy, Cal.
Placer Herald, Auburn, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Stockton Record, Stockton, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–115	Ancient channel drift placer. Gravel 2′–6′ deep, 25′ wide. Drain tunnel 400′ in length. Gravity proposition.
02–116	Oil land 4 to 6 miles southwest of Kern River Field.
02–117	500–600 tons high grade orthoclase feldspar.
02–118	Four quartz claims; 2 ledges average 2′ wide; assays $12.50 gold. Considerable development. Small mill near property. Mariposa County.
02–119	Drift placer mine, Lowell Hill, Nevada County. Easy terms.
02–120	Asbestos, barite, and dolomite deposits.
02–121	Wollastonite deposit.
02–122	Magnesite.
02–123	Patented placer mine in Fresno County. 14 claims.

Mineral Products or Deposits Wanted.

03–107	Gypsum deposit; must have merit and price within reason.
03–108	Gypsum deposit.
03–109	Platinum group metals.
03–110	Clear quartz crystals.
03–111	Gypsum, for plaster of Paris; deposit or tonnage near San Francisco market.
03–112	Limestone deposit; for fertilizer. Near transportation on east side San Joaquin Valley.
03–113	Chrysotile asbestos; for magnesite cement; deposit.
03–114	Glass sand deposit.
03–115	Strontium ore; tonnage.

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–33 Assistant in office or field with mining company, anywhere. Technical education, civil engineer. Knowledge of typing, bookkeeping and cost-accounting. Experience covers period from 1910 to 1921; details on file. Age 33. Married. References. Salary open.

01–34 Mining Engineer. Nineteen years in managerial and examination work. Experience in Alaska, Canada, Mexico and Central America, in addition to the United States. Age 43. Married. Salary open.

01–35 Plant Engineer-Geologist. Ten years experience with chemical company, copper mine, and in Orient. Age 35. Married. References. Salary wanted $175.

01–36 Mechanical Engineer. Three years experience as tool maker, lathe operator and mechanical engineer with oil and maufacturing companies. Age 25. Single. References. Salary open.

01–37 Superintendent-Manager. Exploration, development or production of gold. Twenty years general engineering experience in gold and coal mining operations. Interview requested for details. Age 43 Married. Salary open.

POSITIONS OPEN.

04–10 Mill Foreman. Take charge of 50-ton mill using ball mill, Overstrom tables and K and K flotation machines. Must be experienced mill man with ability to work out flotation problems. Salary to start $200, less $40 per month for board. Decided chance for advancement.

During the month three openings have been found for registered men.

OCTOBER, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each divison working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. B. TUCKER, Mining Engineer.

Shasta County.

Bell Cow Mine, formerly known as *Arbuckle Mine,* is situated on the southwest slope of Arbuckle Mountain, in sections 35 and 36, T. 30 N., R. 9 W., 18 miles southwest of Ono. Owners: J. W. Carter, J. P. Erhart, Frank A. Greene, S. H. Fisk, and Herbert Fisk of Redding.

Holdings consist of 16 claims, comprising 332 acres. On the property, there is a series of parallel siliceous dikes, the most prominent being west of No. 2 tunnel workings. The general trend of the main veins is northwest and southeast, and dip at from 30 to 40 degrees westerly, toward a massive siliceous dike which is schistose in structure. This dike is 6 to 10 feet in width and extends over the full length of the Bell Cow No. 1 claim and into adjacent claims.

The different veins have been developed by 9 tunnels, at different elevations on the slope of the ridge south of the Middle Fork of Cottonwood Creek. At an elevation of 1800 feet, No. 1 tunnel is a crosscut tunnel driven 500 feet to cut vein opened up in No. 2 tunnel. About 50 feet above No. 1 tunnel, is No. 2 tunnel, driven 203 feet on the main vein. In this tunnel a vein of quartz was developed from 2 to 4 feet in width. Reported to assay from \$10 to \$20 per ton. The shoot is 200 feet long. No. 3 tunnel is a crosscut tunnel, driven 165 feet to cut the same vein, and southeast of this tunnel is No. 4 tunnel, 75 feet in length to the vein. The other tunnels are caved, but reported to be from 20 to 150 feet in length. Total lineal feet of drifts and crosscuts is 1273 feet.

There is a 5-stamp mill on the property, 1050-pound stamps, 7″x9″ Dodge crusher, Challenge ore feeder, amalgamating plates, Woodbury concentrator, all driven by 15-h.p. Fairbanks Morse gas engine.

Idle.

Central Mine. The property is situated in the Old Diggins district, in Sections 33 and 34, T. 33 N., R. 5 W., 8 miles north of Redding. Holdings consist of the following claims: Bertha May, Central, South Central, and Shasta; 60 acres. Owner: A. A. Anthony of Redding. Elevation, 800 feet.

Two parallel veins occur in the meta-andesite, strike being north and south, and dip 65 degrees east. All work has been confined to the Central vein. At an elevation of 1000 feet, a crosscut tunnel has been driven N. 65° E., 200 feet, where it cut the vein, with drifts on the vein, 500 feet north and 200 feet south. Vertical depth below outcrop is 175 feet. Pay shoot developed was 230 feet long and 6 feet wide. Ore was free milling. At an elevation of 800 feet, a lower crosscut tunnel has been driven, 956 feet to the vein, with drift north on vein 644 feet, and 218 feet south. In the south drift, the vein was cut off by an east and west fault. Here a crosscut was driven, 75 feet west and 171 feet east, but it did not cut the vein. The vein in the south drift is 3 to 10 feet wide, but low grade. In the north drift, 208 feet north of crosscut, an ore shoot, 165 feet long was cut which was stoped in places to the upper tunnel. The vein is from 4 to 15 feet wide. This ore was shipped to the smelter at Kennett and is reported to have averaged from 80 cents to $20 per ton. The vein quartz is white, carrying chalcopyrite, and pyrite in small proportions. The gold values are in the sulphides. Equipment consists of cars, track, blacksmith shop, and tools. In 1912, the production was $45,000 and total production is reported to have been $500,000. Two men employed.

Bibliography: State Mineralogist Reports VIII, pp. 565-566; X, p. 631; XII, p. 246; XIII, p. 351; XIV, p. 781.

Florida and Big Gem Group of Mines. This group of mines is situated in Sections 7, 12, 18, T. 31 N., R. 5 W., in Middletown Mining district, 7 miles west of Redding. Elevation, 1000 feet. Owner: G. W. Boswell, of Redding. Holdings consist of 12 claims, totalling 240 acres.

On this group of claims, there are two principal quartz veins, and a series of smaller ones, which occur either on the contact of meta-andesite and slate, or confined entirely to the meta-andesite. The quartz is considerably shattered and iron stained in the fractures. Gold is free and in the sulphides. The Miners Dream vein, is very strong, and can be traced by its extensive outcrop the entire length of the claim. Strike N. 80° E., dip north. Several shafts have been sunk on the vein to a depth of 40 to 50 feet, and in one, a drift has been driven about 100 feet, from which a winze was sunk 50 feet. Here the vein is 12 feet wide. Assays along this vein are said to run from $8 to $20 per ton. The Big Gem ledge, apparently the strongest and most persistent of the group, lies south of the Miners Dream, striking N. 30° W. Its croppings vary from 5 to 15 feet in width and outcrop the whole length of the claim, and beyond its southeasterly limit. It has been developed only by means of some shallow shafts, the deepest being sunk to a depth of 70 feet. Besides the veins described, the others are all well defined quartz ledges, but only developed to a small extent. One man employed.

The Gold Leaf Mine, situated 4 miles west of Redding, has been transferred to the Gold Leaf Mining Company by Ira Judson Coe, Richard F. Tomlinson, and F. W. Heron of San Francisco. Under the supervision of E. L. Anderson, the shaft is being unwatered. It is 400 feet deep. Water has been bailed out to a depth of 221 feet. Two shifts are employed.

H. E. Schoonover, F. C. Walker, Chas. P. Heaney, and B. A. Purcell of McCloud, have located six quartz mines in the Old Star City district. The claims are: Shasta Lily, Tiger Lily, Pond Lily, Heaney, Purcell, and Skoog; known as the *Star City Group* of mines.

William Arps of Copper City, has located five claims in the Pittsburg Mining district, named: Old Massachusetts, A. B. F., Caution, Gay Queen, and Croesus.

The *Shasta Mines and Reduction Company* of Weed, Siskiyou County, has been incorporated to develop the diatomaceous earth deposits in the northeastern part of Shasta County. T. F. Mouche of Weed, Tunis Heyton of Portland, Oregon, and A. D. Fish of Oakland are directors.

The *United States Smelting, Refining and Mining Company,* owner of the Mammoth, and other mines near Kennett, have filed for record, a United States patent for these mines in the Flat Creek mining district, near Kennett: McKinley, Evening Star, Backbone, Storm King, Link, Red Queen, Wedge, Spread Eagle, Ridge, Tom Boy, Canon, Grey Eagle, Connecting Link, Extension, Jumbo, Copper King, Copper Queen, Great View, Good Hope, Summit, American Girl, Merry Mack, and North Pole. The claims embrace portions of Section 18, T. 33 N., R. 5 W., and Sections 14, 15, 23 and 24, T. 33 N., R. 6 W.

Yankee John Mine, situated 6 miles southwest of Redding, and owned by the Yankee John Development Company, home office, Pittsburg, Pennsylvania, is being reopened. Several men are employed on development work, under the supervision of W. L. Clark.

The Lost Channel Gravel Mine, situated near Igo, and owned by C. W. Russell of Igo, is under operation. Several men are employed on development work. Operations are under the supervision of C. W. Russell.

Siskiyou County.

A. Jacquemart of San Francisco, has purchased the *Paddy Cronin Placer Group* of mines, composed of five claims, located five miles below Sawyers Bar, and is making preparations to work this fall.

At present, he is building five miles of ditch which will take water out out of the North Fork of the Salmon. It is reported that the gravel goes over 50 cents per cubic yard.

The *Homestake Quartz Mine,* owned by R. S. Taylor of Yreka, and situated 10 miles southeast of Etna Mills, is being operated and the 2-stamp mill is running. Eleven men are employed.

The *Cub Bear Mine,* situated 12 miles southeast of Etna Mills, is being developed by the Siskiyou Syndicate, Irving J. Luce of Los Angeles, president. In recent development work, a very strong vein showing good values has been opened up.

Fred Myers has leased the *Hickey Homestead Hydraulic Mine,* situated 2 miles west of Sawyers Bar. The property has been operated for the past three months, with encouraging results.

Miles Neilon and W. Putman are developing some claims which they located in 1921, in Counts Gulch. They have uncovered a 4-foot vein of ore, carrying high values in gold.

The *June Bride Mine,* at the head of Trail Creek, is being operated by Benjamin Bull of Cecilville.

S. D. Bradley of Yakima, Washington, and C. W. Welch are operating the *Progressive Placer Mine* in the Beaver Creek district.

Highland Mine, at the head of Trail Creek, a tributary of the East Fork of the Salmon River, about 12½ miles west of Callahan, has been taken over by T. M. Taylor, C. Wilson, and J. R. Porter. Six men are employed on development work, and making repairs to the old mill and pipe line.

Ball Quartz Mine, situated 3½ miles southwest of Sawyers Bar, has been bonded by Fred Gowing of Berkeley. In recent development work on the property, a vein 3 feet wide has been opened, which is reported to run $25 per ton. The 5-stamp mill is being operated steadily on good ore. Twelve men are employed.

The Hoboken Mine, situated 11 miles north of Fort Jones, has been bonded by Diggles and A. H. Bowie to Oakland people, who have eight men working on the property. In a lower tunnel, they have developed a vein having a width of 12 inches to 6 feet. Ore being milled from this vein averages $12 per ton.

Tehama County.

The well of the *Tuscan Oil Company,* 6 miles north of Red Bluff, is down 1800 feet. Superintendent L. F. Richardson, reports that steady progress is being made in the drilling operations. Two shifts are working.

Trinity County.

During the early part of October, the dredge owned by *Lewis Gardella* of Oroville, which is located on the Paulson ranch across the river from Lewiston, started operation. Claude Enslow, superintendent.

The *Unity Hydraulic Mine,* situated 4 miles north of Minersville, on the East Fork of Stewarts Fork, in Sections 27, 28, T. 35 N., R. 8 W., has been recently purchased by the *Nugget Bar Placer Company* of Oakland. J. A. Gillice is president and general manager. Fred Kendall, superintendent.

Holdings consist of following claims: Rowles Placer Mine, Minersville Placer Mining Claim, Italian Placer Mine, Shady Gulch Placer Mine, Oak Placer Mine, Hayward No. 2 Placer Mine; comprises 610 acres. Elevation, 2200 feet. In previous years, the property was worked by two hydraulic pits, on the west side of the East Fork of Stewarts Fork.

Bedrock is diorite and slate. There is 20 to 60 feet of gravel, with clay soil overburden. Course of channel is north and south. Water is secured from the East Fork of Stewarts Fork, through a ditch 3½ miles long. Gravel wash shows granite, slate, and porphyry boulders, with a small amount of large boulders.

Twenty-five men are employed building a flume and getting ready to operate the property, this winter.

Gifford Mine. It is situated 5 miles northeast of Lewiston, in Section 3, T. 33 N., R. 8 W., on the slope of the ridge south of Eastman Gulch. Elevation 3050 feet. Claims: Blue Jay, Confidence, Mountain Echo, and Battle Axe; comprises 70 acres.

A series of parallel veins of quartz occur in granite-porphyry, in close proximity to the contact with granite-porphyry and meta-andesite. The general course of the veins is N. 40° E., dips 45° to 70° southeast. Width from 12 inches to 2 feet.

Developments consist of four crosscut tunnels, driven at different elevations. Recent development work has been confined to driving the Richards & Lindermuth crosscut tunnel to develop the shoot of ore worked in the upper tunnels. At an elevation of 3050 feet, the tunnel is driven S. 19° W., 700 feet, at 180 feet from the portal it cut the contact of meta-andesite and granite-porphyry. Porphyry lies on the west with meta-andesite on the east. Contact strikes N. and S., dips 60° E. At 680 feet it cut an E. and W. fault, dip 75° S. The vein is faulted 29 feet to the south. A drift has been run 40 feet west on this fault where it cut a vein which strikes N. E.–S. W. and dips 45° S. E. The vein has a width of 16 inches and is reported to assay $250 per ton.

Quartz contains a large percentage of sulphides, showing free gold, pyrite, galena and arsenopyrite. At 600 feet from the portal, the tunnel cut a N. and S. fault. In an upraise, 30 feet above the drift, a vein of quartz was cut which strikes N. 30° E. and dips 80° E. Width 12 inches to 2 feet. Assays taken along the vein for a distance of 40 feet, gave an average value of $20 per ton. Above the Richards tunnel 115 feet is the Lane tunnel, which is driven south 400 feet, then southeast 280 feet. At 560 feet from the portal of this tunnel, it cut a contact between meta-andesite and porphyry. Drift runs 80 feet to southwest, where it cut an E.–W. fault. A raise on the fault cut a vein 5 feet wide. The Wilson and Ehrman tunnel is 155 feet above the Lane tunnel. It is driven southeast 280 feet to the vein, turned southwest 100 feet and then 80 to the northeast on the vein. There is reported to be a large amount of ore in the upper workings, as only a high-grade streak was mined.

Assay value of shipments made from the property from January, 1907, to October, 1920, ran from 10 to 20 ounces in gold. The mine has a reported production of $75,000.

Equipment consists of cars, track, blacksmith shop, tools, and bunk house. J. F. Gifford of Lewiston, owner. Property under option to Clyde F. Richards and associates of Los Angeles. Two men are employed on development work.

Venicia Mine. The property is situated 6 miles northeast of Lewiston, on the ridge between Eastman Gulch and Jennings Gulch, in Secs. 2 and 3; T. 33 N., R. 8 W., elevation 3300 feet. Owner, L. S. Paulson of Lewiston. Under option to John E. Bennett and associates of San Jose.

Claims: Venicia, Hopeful, Blakemore, Providence, (½ claim) Rattler, Deerhorn, Venicia No. 2, and 4 new locations. Holdings comprise 230 acres. A series of parallel quartz veins occur in the granite-porphyry; strike N.E. and S.W., dip 80° E. The lower tunnel, cut a north and south vein, dipping 80° east. Ore occurs in lenticular lenses. Quartz carries heavy sulphide, showing free gold, pyrite, galena, and arsenopyrite. Width of veins varies from 12 inches to 3 feet.

Developments consist of five tunnels, the four upper tunnels being on the Venicia vein which strikes northeast and southwest and dips 80° east. Width 2 to 3 feet. Present development confined to driving No. 5 tunnel to intersect Venicia vein, 150 feet below old workings. In driving this tunnel, it cut a north and south vein 202 feet from portal of tunnel. This vein is being drifted on to the north. The vein has a width of 6 inches to 3 feet, and carries high values in gold. Average width of high grade ore is 12 inches, and reported to assay from $100 to $600 per ton. In this north drift, a winze has been sunk to a depth of 20 feet. The vein in the winze averages 12 inches in width. The quartz shows a high percentage of pyrite and galena, also some free gold. Also driving N. 85° E., in this tunnel to cut the Venicia vein. No. 3 tunnel is 150 feet above No. 5 tunnel and driven N. 70° E., parallel to the Venicia vein. At 156 feet from the portal it crosscuts to the vein and then follows it for 750 feet. In workings on tunnel No. 3 level, there is reported to be a large tonnage of milling ore, as only the high grade streak was mined, and shipped. Samples taken at intervals in these workings are reported to assay from $10 to $20 per ton.

No. 4 tunnel is driven on the opposite slope of the ridge to the south, 1200 feet. It is connected with No. 3 tunnel by a raise of 50 feet in height. Reported production from upper workings, $500,000.

Equipment consists of cars, blacksmith shop, tools, track, and bunk houses. Four men are employed on development work. W. A. Henderson, superintendent.

Trinity Mohawk Mine. The property is situated 15 miles northwest of French Gulch, on the south slope of the Trinity Range of mountains, between Mooney Gulch and Little Papoose Creek. It is in T. 34 W., R. 8 W. Owner: J. H. King of Redding.

The Trinity Mohawk group consists of 11 claims, and the Golden Oaks group, comprising three claims; total 280 acres. A series of parallel quartz veins occur on the contact of slate and diorite-porphyry. These veins have a general strike of N. 80° W., with dips varying from 25 to 45 degrees north. Widths 3 to 10 feet. Vein filling is white quartz carrying a small percentage of pyrite. At an elevation of 3880 feet, the Trinity Mohawk group is developed by two crosscut tunnels. These workings are 122 feet apart and one is 200 feet in length, the other 194 feet. Samples taken from an open cut on the vein above these tunnels are reported to assay from $8 to $18 per ton. Above tunnel No. 1, an incline shaft has been sunk to a depth of 42 feet. The vein near the surface in these workings has a dip of 40° N., but near the bottom of the incline flattens out to 15°. The vein has an average width of 4 feet. Over No. 2 tunnel, which lies west of No. 1, an incline shaft has been sunk to a depth of 20 feet. Here the vein has a width of 10 feet. An open cut has been made along the vein for a distance of 100 feet west of No. 1 incline shaft.

This vein has not been cut in either crosscut tunnel. Near the top of the ridge, at an elevation of 4300 feet, there are a series of parallel veins in the slate, and shallow open cuts expose 4 to 8 feet of quartz. On the Golden Oaks claims, there are 12 parallel quartz veins in diorite-porphyry, which have a general N. 80° W. trend and dip 40° N. A number of shallow open cuts have been made along the outcrops.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

Sierra County.

QUARTZ MINING IN THE ALLEGHANY DISTRICT.

Mining in this district has recovered from the setbacks of the past few years and the region is daily gaining more attention due to recent successes in the operation of a few properties. Several small outfits are prospecting and promotion and exploration plans are announced from time to time as one after another of the old mines and prospects are taken up.

Geography. The town of Alleghany is near the center of an area of about fourteen square miles extending from Oregon Creek on the north to the Middle Fork of Yuba River, in which there are many old gravel mines and more than 150 quartz locations. Kanaka Creek and its branches flow southwest past the town, carving a deep canyon which has offered sites for numerous adits. Alleghany has an elevation of 4700 feet, with considerable snow in winter. The new Foote road is 32 miles long from Nevada City and the shortest way to the railroad. It was built at a reported cost of $87,000 through the efforts of A. D. Foote. Freight costs a cent a pound from Nevada City. The accompanying map shows the location of most of the mines mentioned in this report. It is not accurate in all details, but will help the reader to locate the different properties.

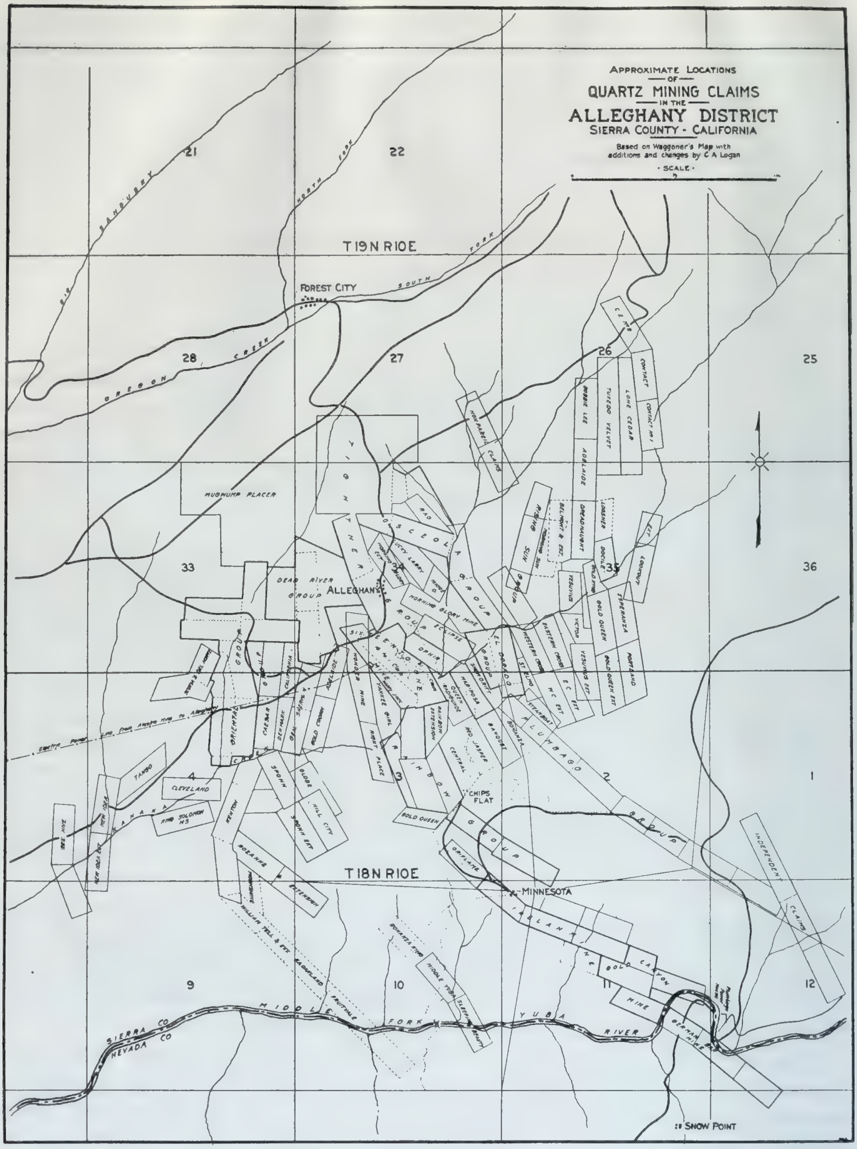
Power. Electric power for the mines is supplied by the Middle Yuba Hydro-electric Co. which has a line from the Alaska Mine at Pike City to Alleghany, with a local substation on the Happy Jack claim one-half mile south of town. A few mines have water rights that permit the direct use of water for power, or the generation of electricity.

Geology. The areal geology of the district was covered in the Colfax folio of the U. S. G. S., but this map is on a scale that does not permit enough detail for use in a study of the mines. H. G. Ferguson[1] wrote a short report upon the geology of the district, with a discussion of the mineralogy and ore deposits as far as revealed at the time of his visit, nine years ago. His paper is the only one extant dealing with these points in any detail. This Bureau's last county report also contains some additional details but there have been many changes and a great deal of development work since it was published.

In the following pages the individual mines are discussed, particularly as regards development underground, production and present condition. The statements made regarding conditions underground are based in nearly every instance upon the writer's observations, when the mines

---

[1] Ferguson, H. G., U. S. Geol. Survey Bulletin 580.



were accessible. Where inaccessible, the data was gathered from mine maps, and where these were not to be had, from owners or operators.

The principal rocks of the district are amphibolite schist, serpentine, and the metamorphosed rocks of the Carboniferous, once sedimentary but now slates, schists and quartzite. These strata have been compressed and folded by forces acting along a northeast-southwest direction. The amphibolite shows the same dip of schistosity in general to the east-northeast. The amphibolite schist has been considered as derived from gabbro by pressure, and the serpentine is probably derived from peridotite or pyroxenite. The inference is that the serpentine is derived from rock that was originally injected into the older gabbro or amphibolite as sills and dikes. The 'bluejay' of the wall rock near the vein is an aggregate of quartz, dolomitic marble and calcite, of varying composition, containing more or less quartz but sometimes essentially a dolomite, and nearly always colored by green mariposite, derived from the serpentine. This mineral is a characteristic of the California gold belt wherever serpentine is prominent.

Most of the veins of the district have strikes between north and west, and dip northeast. The dip is generally less than that of the schistosity of the amphibolite schist, in which most of them have their principal development. There have been recurrent periods during which the fissures in the amphibolite have stood open for the formation of quartz veins, but there seems to be plenty of evidence to support the contention that the veins do not live in the serpentine for any great distance, although it may be reasonable to look to the parent rock of the serpentine as an agent for some of the phenomena of the ore formation. The mines have not yet been worked deep enough to prove that the very rich specimen ore will persist below the ground water level. There are some indications to show that as this level is approached, there is more of the pay in sulphide ore of lower tenor and in larger shoots. Rich specimen ore has been found under such a variety of conditions that experienced operators are adverse to naming any particular indications as necessary accompaniments of 'high grade.' The writer has concluded that it would be of interest and value to set down as many of these observations as were brought to his attention by mine foremen and superintendents who have been working in the mines for years, who have found pay where it was least expected, and have failed to find it where all past signs pointed to it.

A broken footwall or hangingwall seems to be most often alluded to as being near or with 'high grade.' Such breaks may mark the points of entry for mineralizing solutions. On the other hand, a thick layer of talc on the footwall has been found more than once in particularly poor places. Many of the veins show a marked tendency to branch into the footwall; the hangingwall is as a rule more distinct and firm. The broadening of a vein and marked disturbances in the nearby walls, incident to the approach of another vein, may be favorable for ore, which may be found outside of the main vein itself. The occurrence of water courses is thought favorable. 'Bluejay' of a particularly bright tint is held to be especially favorable. Ribbon structure in the veins is prominent, but not a mark for high grade ore, though often occurring with bodies of milling grade. The typical pocket rock, as pointed out underground, is a dead snowy white quartz. Arsenopyrite is always regarded expectantly, but is not always rich enough to be classed as high grade ore. Ribbon structure may show either arsenopyrite or the finely ground black schist in the ribbons.

Samples of the wall rocks from a number of the mines were taken by the writer and it is hoped that thin sections can be prepared from these and that the results of studying them under the microscope can be published later. The great amount of secondary carbonate rocks and the persistence of the lenses of black slaty schists are interesting and worth studying because of their probable influence on the ore deposits.

Belmont Group comprises two locations, Belmont and Belmont Annex, in the N.W. ¼ Section 35, T. 19 N., R. 10 E.; and is reached by the Mariposa Mine road and a trail from Alleghany. Owners, Mrs. L. C. Harden and Peter Flowers. Flowers is at present working alone, following a vein showing ore about six inches wide. During the summer just past, he had a mill test of about 1500 pounds of ore that yielded $15 gold and he occasionally mortars specimen rock showing a few dollars. There are several short adits, up to 150 feet in length.

Brush Creek Mine is outside the area of the Alleghany district as here described. It is at Mountain House and the vein is on the contact of the slates and the western area of serpentine that passes about three miles west of Alleghany. There is an old shaft said to be 800 feet deep, and adits. Work began during the month of September. A power line is to be built a mile and a quarter from the Kate Hardy Mine, and an old adit will probably be advanced toward the shaft.

The vein is supposed to be the same as that in the Kate Hardy Mine, under which it is more fully described. The Brush Creek Mine was an early producer, with a record for good ore. In 1869 there was a 20-stamp mill on the property and during that year the mine produced for the first eight months ore that averaged $31.31 a ton and in December of the same year averaged $42.50 a ton, according to an old report. It was then being worked to a depth of 300 feet.

Contact Mines. F. J. Hulaniski, president, Drawer K, Richmond, Cal. C. H. Weldon, superintendent, Alleghany. The group contains five unpatented claims covering 3000 feet along the contact of slate and serpentine, four miles by road and trail west of Alleghany and just north of the Foote road. It is believed by the operators to be on the southward extension of the Kate Hardy contact.

The adit portal is on Contact No. 1 claim, 150 feet from the south end-line and when visited September 20 had a total length of 206 feet, of which a few feet are crosscut and the balance on the vein or in the fissure filling. This adit was then about 75 feet below the surface at the face and will give increasing depth northward. The vein strikes N. 20° W. and dips 70° to 80° west. In the face when visited it showed stringers of quartz, crushed slate and the characteristic 'bluejay' or mariposite-dolomite rock of the district. A few feet back from the face, the roof of the drift was quartz for its entire width. A crosscut of eleven feet into the footwall showed 'bluejay' entirely. The hangingwall is slaty schist, usually dark and in places resembling serpentine. The serpentine of the footwall is only a short distance from the tunnel, which is being turned to reach it.

The vein so far has pinched and swelled abruptly and many high assays have been reported from it, but most of these were picked and therefore of little value in forming an estimate of the average value. The presence of 'bluejay' in such quantity on the east is the best sign so far encountered.

There is a small air compressor run by a 40-h.p. tractor engine, furnishing air for drilling. There are some dwellings on the claims.

Dead River Group adjoins the town of Alleghany on the west, and comprises the Dead River and Lackawanna Placer claims and the Wyoming and Wyoming Extension lode claims. The Dead River was prospected for gravel without much resulting. A crosscut was driven from the Happy Jack claim across the Wonder claim, for a distance of 1700 feet, striking a vein reported by the owner to be 3 feet to 5 feet wide, with serpentine on the east and slate on the west. This vein was found about on the end line common to the Wyoming and Wyoming Extension claims and was drifted on for about 200 feet and a winze was sunk 100 feet, according to Weiland. The adit is at an elevation of 4600 feet.

The property has been recently under consideration by an engineer for the Tonopah Mining Company interests. A plan for working the two above claims through the Oriental main adit has been entertained. This latter adit enters the ridge at an elevation of 4050 feet, is supposed to be in good shape, and could be continued eastward across the Lackawanna claim to prospect the Wyoming claims 600 feet deeper than yet reached. Stanley Weiland, Scranton, Pa., owner.

Docile Mine comprising Docile and Loosner claims, has been idle since the last report. Reported production about $100,000. The old 10-stamp mill has been exposed to the weather for years.

> *Bibliography*: State Mineralogist Report XII, page 264; and Register of Mines, 1903, page 4.

Dreadnaught Mine comprises the Dreadnaught and Seneca Fraction claims, west of the Docile in Section 35, T. 19 N., R. 10 E. It has been idle for a number of years. There is a 1-stamp mill, now in ruins.

> *Bibliography*: State Mineralogist Report XII; also Mines and Mineral Resources of Sierra County, California, State Mining Bureau, 1918.

Edwards Group of claims lies between the Plumbago and Rainbow Mines near Chips Flat. There are four quartz locations, called Bonanza, Banquet, Red Jasper and Central, and these are partly covered by a placer claim called the Chips Flat Placer, containing 40 acres. E. Edwards of Alleghany is the locator. On the Red Jasper claim, which is a south extension of the Queen Radigunde, there is a tunnel 700 feet long which taps a gravel deposit and cuts one vein which the owner reports is 4 feet wide. On the Banquet claim, formerly called the Bonanza, there is a cut and adit 40 feet long entering but not bottoming the gravel.

El Dorado Mine, Fessler Estate, Alleghany, owners. Under lease and option to El Dorado Wisconsin G. M. & M. Co., 816 Tribune Bldg., Chicago. Eugene Yahr, president. Comprises three claims, El Dorado, El Dorado Extension and Gold Bullion or Terrible, the latter on a second vein.

The El Dorado vein has been developed by a series of adits driven on the vein from the south bank of Little Kanaka Creek, and higher on the same side. The vein has a strike varying from S. 33° E. to S. 45° W. and dips about 45° east or northeast. No. 1 adit is about 475 feet long and 130 feet below the outcrop on the dip of vein. An area 120 feet long by 60 feet high, beginning 60 feet from the portal, has been stoped above this level. No. 2 adit is about 110 feet below No. 1

on the dip and is 475 feet long. A small area was mined between these two adits. No. 3 adit is near the level of No. 4 and 250 feet west of it. It is 440 feet long and 340 feet below No. 2 on the dip. It is caved at the portal.

No. 4 is the present working entry and the place where best observation is possible. It runs as a crosscut 60 feet to the vein from a few feet above the level of the creek on the south side, thence for 410 feet on the vein in a general course S. 33° E. to raise No. 2. There it turns S. 56° E. for 600 feet to an abrupt bend in the vein, where the tunnel takes a course southwest and south to the face. Raises and winzes were driven from this adit as follows: Raise No. 1, 170 feet from the portal is up about 30 feet. Raise No. 2 is 470 feet in and up 60 feet above the adit with an upper level driven south 120 feet and north 30 feet. Raise No. 3 is 790 feet in, and Raise No. 4 is 860 feet in. Between these, specimen rock has been mined. One hundred fifty feet beyond, or 1010 feet from the portal, a winze has been sunk on the vein 200 feet, with levels at 100 and 150 feet. From the 100-level, the vein has been drifted north 300 feet and south 50 feet; on the 150-level south 400 feet and north 75 feet. These lower workings are at present full of water. The vein is said to be 4 feet wide in the bottom of the shaft and 7 feet wide in the south on the 150-level, but in a pinch on the north. Twenty feet beyond the winze is Raise No. 5 connecting with the face of No. 2 adit, with a sub-level two-thirds the way up, that runs northwest 300 feet. Some high grade ore was stoped here in a length of 70 feet nearly up to No. 2 adit and in a winze 35 feet below the level. From the shaft to the face is about 430 feet. The face is 800 feet on the dip of the vein from the surface. About 125 feet back from the face ore said to have averaged $10 a ton was stoped for a length of 75 feet and a height of 225 feet and was followed 80 feet below the level in a winze. The formation of this ore is attributed to the intersection of a stringer 6 inches wide, striking east and dipping north, which comes up to the main vein from the footwall but does not pass through into the hangingwall. The ore was along and near the intersection.

The vein at the face of No. 4 adit and for 110 feet back, strikes nearly due south and dips 45° east. It has a width up to 7 feet with a hangingwall of black slaty schist, and a lens of hangingwall rock a foot thick next the vein has been ground to gouge. The vein is similar to others in the district, of white quartz and ribbon rock. The footwall is of broken black slaty layers with 'bluejay' very prominent. The rock of both walls seems to have been a dark fine grained igneous rock originally. The tendency of the vein to branch into the footwall and the altered and shattered character of the latter, raises the doubt as to whether the real footwall has been reached. Coming from the face toward the portal, the vein enters a pinch 150 feet from the face, and is pinched for 300 feet. Here the serpentine hangingwall bends out, bending the vein. Three hundred fifty feet from the face, a stope 40 feet by 40 feet on high grade ore was thought by Superintendent Fessler to have been formed from stringers coming in from the hangingwall. Stringers also enter here from the footwall, however, in which 'bluejay' is prominent. An interesting but so far unproductive split occurs in the vein 550 feet from the portal. The quartz pinches here and the fissure is filled by a horse. The well marked footwall was followed by a drift 80 feet long, S. 23° E. and at the face of this drift the two walls are about 40 feet apart. The hangingwall at the split is firm and well defined and holds a course of S. 38° E. Entering from the footwall, a well marked, nearly horizontal floor cuts through the horse in the roof of the drift but does not enter the hangingwall. From here out in the main drift the vein is big for 180 feet, then pinches for 90 feet, again swelling for 140 feet and so on.

G. S. Fessler states the mine has produced $225,000 from No. 4 adit to the surface. The present company began work March 24, 1919, and began milling in March, 1920. They report 4591 tons crushed, for gross returns of $52,652. Of this amount, 1408 tons of ore from the 150 ft. winze and its drifts yielded $9,448 and 336 tons from the winze farther in yielded $3,573. Concentrate is reported to form 2 per cent of ore and to be worth $129 to $169 a ton. This company did all the work below No. 4 adit and also drove the adit ahead 360 feet.

The mine has an air compressor run by 75-h.p. motor, electricity having been brought in to supplement water power. The old mill of ten 850-pound stamps will crush about 20 tons a day. A secondhand mill of twenty 1250-pound stamps has been bought and excavation for it is going on. At present it is planned to run the old mill with a 40-h.p. tractor engine. Sufficient water can be had from the creek to run the old 10-stamp about half the year.

Gold Canyon Mine adjoins the Irelan on the east, in the east half of Section 11, T. 18 N., R. 10 E. adjacent to Middle Fork of Yuba River. Our last report describes the workings. Little new underground work has been done since it was written. The last operators unwatered the workings and did some diamond drilling from the lowest level, which is about 360 feet deep, to an added depth of 400 feet, but report the vein was not found. This failure to find the vein has been attributed to the fissure passing into the serpentine, where it is presumed to pinch.

The main production, stated to have been $740,000 came from an ore shoot 285 feet long, 360 feet deep and with an average width of three feet. This was in the amphibolite near the serpentine; when the vein struck the serpentine a former operator reports that it broke into stringers and died. The last pay came from a winze sunk a few feet below the lowest level, 125 feet from the serpentine contact. Present lessees are prospecting for pockets in the upper levels. The mill has been burnt down since the last report.

Gold King Prospect is in Sec. 5, T. 18 N., R. 10 E. four miles southwest of Alleghany and adjoining the Contact No. 1 claim of the Contact Mines, on the south. An adit has been driven some 200 feet but there is no work being done now and the writer did not examine the showing underground. C. H. Weldon is in charge.

Golden King Mine has been idle since the last report. It is in Section 35 adjoining the Dreadnaught on the south, and is equipped with a 10-stamp mill, built about 1895 and buildings that are falling to ruin.

Bibliography: State Mineralogist Report XIII, p. 377; and Mines and Mineral Resources of Sierra County, 1918, p. 90.

Granger Prospect (*De Luxe Prospect*). This is on Kanaka Creek about three miles southwest of Alleghany, and near the west contact of the same area of serpentine that passes the contact claims. The last adit driven is 25 feet above the creek on the east bank. It runs south 75 feet on a stringer lead. Both walls are chloritic schist and the adit is just west of the serpentine contact. This adit shows a little quartz all the way in, but nowhere over a foot wide and less than that at the face. The quartz stringers are encased in a layer of black slate which persists even when the stringer pinches down to 2 inches. The prospect was idle when visited. There is a good dwelling on it but no mining equipment. S. Granger, Alleghany, owner.

Irelan Mine comprises 4 claims with a length of 4500 feet along the strike, in the northwest part of Section 11, T. 18 N., R. 10 E, at the old camp of Minnesota. It is 36 miles to Nevada City by road and three miles by trail from Alleghany. W. T. Waldron is manager.

The vein, which strikes N. 53° W. and dips 50° east, has been developed by a series of adits. The old Irelan adit is 800 feet long on the vein, on the same level as the present entry, but southeast of it. In the canyon 800 feet lower on the dip of the vein, is the lower adit, 1100 feet long and all on the vein, but without any raises above it and no production to its credit yet. It has to be driven 400 feet further north to be under the crosscut where the latter intersects the vein in the upper adit. The new upper adit is a crosscut west 200 feet, striking the Irelan vein about the middle of the center claim, where the old adit ends, and is drifted thence 1200 feet northwest on the vein. At a point 1170 feet from the portal a winze is sunk 100 feet on the vein and a level at 80 feet is drifted each way about 100 feet on the vein (Sept. 20). From its intersection with the Irelan vein, the crosscut is continued 200 feet to the footwall vein, on which a drift was run 100 feet southeast and 150 feet northwest, with some production. Work at present is on the Irelan vein in the lower level, which is 300 feet on the dip of vein from the surface. The vein is thought to be worked out as far as drifted above the present adit.

Bunches of specimen ore and rich arsenopyrite have been mined in stopes and raises, the highest going up 200 feet above the drift. This work has been done for a distance of 200 feet each way along the adit from the shaft. Good ore has also been stoped between the bottom level and the adit. The vein in the south face of the drift on the bottom level strikes S. 53° E. and dips 50° N. E. Next to the hangingwall are two distinct ribbons of quartz, 1 inch and 4 inches wide, underlain by a layer of hard dead-white quartz 2 feet thick, having the characteristic appearance of pocket rock. This is underlain by a pronounced slippage plane and a foot of crushed quartz with arsenopyrite in stringers. The bounding planes of these separate layers in the vein are all inclined at a sharp angle to the hangingwall, indicating considerable post-mineral movement at this angle, which is flatter than the original fissure. Next the footwall lies a horse of fine grained light colored altered dike. The footwall for a foot or more next the vein is crushed black slaty schist, filled with quartz stringers. In the north face of this drift and in the level above, a very interesting feature is the occurrence of a distinct breccia of quartz fragments up to an inch in diameter in the hangingwall portion of the vein. These fragments have been recemented by brown chalcedony. In the north face, the cementing material of the breccia has the appearance of a greasy, dark colored quartz and is thickly filled with crystals of arsenopyrite, from microscopic size to nests of crystals which fill seams $\frac{1}{4}$ inch wide. No specimens were seen where the arsenopyrite entered the white quartz fragments, and this would indicate that the arsenopyrite was brought in after the original vein was formed and crushed by the movements alluded to above. This mineralized breccia is said to be good ore. The arsenopyrite may assay very high at times, but does not as a rule show the massive pockets of gold found at a few of the mines. The kaolinized and intensely altered hangingwall is shot full of stringers of the later blue quartz. Pyrite is prominent in the wall rock. The country rock near the mine is amphibolite, with serpentine near on the hangingwall.

W. T. Waldron states the mine produced $250,000 previous to 1880. His company started work in 1913, since which time about $100,000 is said to have been taken out. Three mills have been installed, but the present one of ten stamps is the only one that gave satisfaction. A coarse screen is used for low grade ore and a fine one for high grade. The concentrate is said to be low grade as a rule. Electric power is supplied by the company's line, 2½ miles long, from Alleghany.

Kanaka Prospect is a mile southwest of the Kenton Mine on Kanaka Creek. There are three claims called Kanaka, Kanaka Extension and the Panama. They are on the east contact of the large area of serpentine that extends from Mountain House. Ambrose Madden of Alleghany is the owner.

This property was not visited. Madden reports that a tunnel has been run on the Kanaka claim between the creek and the Foote road, and is in 420 feet, including two drifts, 100 feet and 75 feet long, respectively. He reports taking a few small bunches from this tunnel, in all amounting to $467. One report from Selbys is said to show that ten pounds of quartz yielded $99.85. An upper adit at the roadside and 130 feet above the lower, is a crosscut 40 feet and for ten feet is on a stringer lead said to assay well, and to be of good width.

Madden has a dam across the creek and a pipe line 400 feet long. He plans to install a water wheel next spring to supply power.

Kate Hardy Mine is three miles southwest of Forest on Oregon Creek in Sections 29 and 32, T. 19 N., R. 10 E. Kate Hardy Mining Company, Frank A. Sullivan, Secretary, Santa Rosa, Calif., has been operating under a lease and option but the mine was temporarily idle when visited and the information below was furnished by W. W. Casserly, Superintendent.

The vein has a wide outcrop and in the lower workings is said to have a width of 80 feet in the widest place. It strikes N. 24° W. and dips 80° W. The principal pay shoot pitches N. 30° in the plane of the vein, coincident apparently with flat cracks having the same pitch.

Since our last report the lowest adit has been run 850 feet on the vein, with a winze 160 feet deep on the vein below the adit and 350 feet from the portal of the adit. Drifting has been going on from the bottom of this winze northerly, and Casserly estimated that 350 feet must still be run to reach the ore shoot, which crosses the lower tunnel 200 feet north of the shaft. From a point 500 feet in the adit there is a raise up 90 feet said to be in pay ore. From No. 3 upper adit, which is about 400 feet long, they claim to have cut the shoot and raised 50 feet on it. Casserly estimates that a pitch length of 260 feet of ore is shown by the present developments on this shoot. Ore thought to indicate another shoot is reported from a raise 30 feet high about 50 feet from the face of the lower adit.

A width of six feet next the footwall is said to carry most of the gold found. The gold occurs mostly in lumps of arsenopyrite, showing oxidation on the outside. Little gold has been found in the white quartz outside the arsenopyrite. Stringers making into the vein from the footwall are thought by Casserly to bring in the pay. The footwall is amphibolite, with talc at times 4 feet thick on this wall. The hangingwall is curved and broken black slate with gouge up to 18 inches thick. Casserly has observed that the best ore seems to occur where the talc layer is narrowest, inferring that where it is thick it has formed an impervious barrier. Outside the six foot layer mentioned, the vein contains principally pyrite with little gold. The present company has milled 1500 tons of ore averaging $10 a ton, from the portion of the vein within six feet of the footwall.

The property is equipped with a good 10-stamp mill, compressor, electric power and a good set of buildings, with a large reserve of timber and mine supplies.

Kenton Mine comprises Kenton, King Solomon, King Solomon Millsite and a fraction, on the south side of Kanaka Creek, a mile and a half southwest of Alleghany. It was bonded in September, 1922, to Charles Burlock of San Diego and W. H. Rowe of Los Angeles. The buildings are being repaired preparatory to underground work.

The Kenton was developed by a series of crosscut adits to a depth of about 250 feet. It is reported that a new adit will be started 50 feet above Kanaka Creek. This would have to be run 900 feet, it is estimated, to strike the vein, and will be 300 feet below the old lower tunnel. The old workings and geology of the mine have been described in publications cited (1) and (2) in the bibliography.

There is an old mill containing 18 stamps, an air compressor, and an electric power line on the property. The past production from drifts and stopes in the two upper adits, is not definitely known, but has been considerable.

Mahady Prospect comprises two claims between the Rainbow and Irelan Mines near the old camp of Minnesota. D. C. Mahady is prospecting alone and has several hundred feet of drifts run.

Mariposa Mine. S. A. Grant and Mrs. Selinda Appel of Palo Alto, owners. The Mariposa joins the Ophir on the south side of Little Kanaka Creek near its mouth, in the northeast corner of Section 3, T. 18 N., R. 10 E. and is reached by road or trail from Alleghany.

The Mariposa was leased to Covenay and Hilmsley in 1915 and 1916 and they are locally reported to have taken out good pay. Later the Mariposa Mines Association prospected the claim at the same time they were working on the Ophir, but gave it up in favor of the latter.

The Mariposa main adit, elevation 3922 feet, runs southeast 758 feet from near the creek. At the face it is 400 feet vertically below the surface. The vein is stated to average 1½ to 2 feet wide, but swelling in places to 4 feet. Its strike varies from N. 30° W. to N. 60° W. and it has an average dip of 50° E. to the lowest level opened. It is said to pinch at the face. The mine was closed when visited in September, 1922, and the lower levels were full of water. The following development has been done according to the mine map.

About 200 feet from the mouth of the main adit a shaft has been sunk on the vein with levels called 50, 100, 140, 180 and 300 levels, the last named being 197 feet vertically below the adit. These levels have been drifted as follows:

50 level, NW. 70 feet and SE. 40 feet;
100 level, NW. 40 feet and SE. 110 feet;
140 level, NW. 210 feet on footwall split;
Appel drift, near 140 level on hangingwall vein, is drifted 155 feet SE.;
180 level, drift 110 feet SE. on hangingwall vein;
300 level, drift 300 feet SE. and 300 feet NW.

The vein split about the 100-level. On the 300-level S. E. the vein turned into the footwall 110 feet from the shaft, striking S. 30° E. and and for the next 120 feet the drift was not on the vein, but it then reentered the vein. In the intervening distance one crosscut into the footwall produced pay. In the northwest drift which is crooked on the 300-level, there is a 65-foot crosscut north at the face.

The principal ore shoot pitched southeast. It was stoped on the main adit level for 140 feet northward from the shaft, and upward to the surface; on the 50-foot level, 70 feet long northward from the shaft, and on the 180-foot level, 100 feet southward from the shaft. The total production to and including 1918, when the last work was done, was estimated at $150,000. There is a building housing a compressor and motor, shop, etc. on the property, and electric power at hand.

Morning Glory Mine comprises the Morning Glory and Minnie D. Extension unpatented claims in section 34, $\frac{1}{2}$ mile by trail from Alleghany on both banks of Big Kanaka Creek. Estates of Martin and Christina Rohrig, owners. A. A. Codd, Reno, Nev., lessee. It was idle in September, 1922, and the lower workings full of water, but the details below were furnished by M. Rohrig.

The claims cover two veins. On the Morning Glory claim adits have been driven westward from the east end of claim. The main adit is 600 feet long, all on the vein, which strikes nearly west and dips north and northeast, varying from 3 inches to six feet wide. About 75 feet on the dip below the upper adit, a drain tunnel has been run west 800 feet on the vein. From the mouth of the upper adit, a shaft was sunk passing through the drain tunnel 120 feet from the portal and reaches 180 feet on the dip below the drain tunnel. One hundred feet below the drain tunnel, drifts were run 50 feet each way, and the same distances were drifted on the 180-level. Rohrig states the vein shows well in the faces of the west drifts but pinches on the east. There still remains about 500 feet west and 200 feet east on the Morning Glory claim unexplored. An area 30 feet long by 25 feet high has been stoped between the two tunnels, and a similar sized block from the 180-level. The Rohrig family produced about $45,000 from the claim above the drain tunnel 25 years ago, and Codd has produced about $5,000.

There are three adits, each about 400 feet long, driven eastward from near the center of the Minnie D. Extension claim. These have partly prospected a block of ground 215 feet deep on the dip. The vein is said to have a maximum width of four feet, usually less, and dips south toward the Morning Glory vein. There is a winze 40 feet deep from the middle adit 300 feet from the portal. A block 40 feet by 40 feet has been stoped and milled but little production has been made, though good prospects are claimed.

On the Morning Glory claim there is a mill containing five 1250-pound stamps and one concentrator. There are also two air compressors capable of running 7 drills. Electric power is used and water for milling is taken from Cumberland Ravine.

Morning Sun claim is a location between the Rising Sun and Dreadnaught Mines covering ground not embraced in the Belmont, which is a senior location. F. W. Nicholls of Alleghany is the owner and has done only a little assessment work.

Moonshine claim is a location adjoining the King Solomon claim on the east. A vein 6 inches wide, striking north and dipping 45° east, is said to be traceable on the serpentine contact for 600 feet. The owner, Geo. W. Hallock of Alleghany, has driven an adit 35 feet in the course of assessment work.

Ophir Mine. This includes the Ophir claim and the portion of Eclipse claim east of Big Kanaka Creek. Under lease and option to Mariposa Mines Association, of which Nathan Haessly is president and Henry Sellenz secretary, address Theresa, Wis. H. I. Murphy, superintendent at the mine. The mine was idle in September, 1922.

The Ophir claim is developed by adits and winzes. The upper adit runs west 610 feet. The lower one, driven later and 140 lower, runs west and northwest 950 feet. Two winzes have been sunk from the lower level—an old shaft to the 200-level, 395 feet from the portal, and a new shaft 386 feet deep on the dip of the vein, with levels called 200, 300 and 400. The collar of the new shaft is at 3944 feet elevation and the 400 level at 3643 feet. The following drifts were run from this shaft:

On 200 level, 600 feet NW. and 260 feet SE.;
On 300 level, 70 feet west and 130 feet east;
On 400 level, 80 feet west and 95 feet east.

There is also a level at 100 feet in the old shaft and this was drilled 45 feet east and 95 feet west.

The vein strikes northwest and dips 52° northeast in the new shaft to a depth of 300 feet where it steepens to 64 degrees northeast. The average thickness stoped was 1½ to 2 feet. On the 200-level, 105 feet west of the shaft, the vein split and a branch went into the hangingwall; the footwall portion is presumably the main vein. The footwall is serpentine and the hangingwall schist.

The principal stopes were one 70 feet long, beginning 290 feet from the portal of the upper adit; one 220 feet long on ore 1½ to 2 feet thick between the two adits beginning 550 feet from the lower portal; one 110 feet long from the 100-level, and stopes and raises for a length of 130 feet on the 200-level. The total production of the Ophir claim is reputed to be $150,000, of which one-third was from the 70 feet in length stoped from the upper adit.

The portion of Eclipse claim held by these owners has been prospected by two adits, an old one running southeast 120 feet, and a new one 400 feet long. In the old adit, which is partly caved, 20 feet in length is said to pan. In the new adit the vein is said to be 6 inches to 2 feet wide. It dips 40 to 67 degrees east and strikes northwest.

The Ophir is equipped with a mill of five 1250-pound stamps, rock breaker, air compressor, and electric motors totalling 163 h. p.

Litigation is in prospect between the 16 to 1 and the Ophir. The former claims that the apex of the vein mined in the Ophir crosses the Ophir side line into the Twenty One claim, and that the Ophir is thereby deprived of extralateral rights. The operators of the Ophir contend that this is not the case and that the vein does not pass through the serpentine contact on that side.

Oriental Mine. Oriental Gold Mining Co. owners. Comprises nine claims as shown on the map, a mile southwest of Alleghany. The mine has been closed several years and little can be definitely learned about it. An adit was driven from Wet Ravine on the southern part of Bluejay claim at an elevation of 4050 feet nearly due north over 3000 feet and then eastward, having a total length of about 5000 feet and prospecting to a small extent six claims of the group. No timber was required for most of this tunnel. The first vein in this adit was struck 150 feet back from the face and was drifted on 200 feet each way without finding pay. At the face a vein five to seven feet thick is said to have been found on which a raise was put up 1000 feet, connecting with the old Oriental shaft. Above the adit several stations were opened and considerable drifting is reported to have been done. The last work was done under lease and bond by the Croesus Gold Mining Co. between 1915 and 1917. A 10-stamp mill with 2 concentrators, an air compressor and good buildings were put up and electric power brought in. As nearly as can be learned, this company produced $28,000. The geology of the property is covered by Ferguson in Bulletin 580, U. S. Geol. Survey.

Oriflame Prospect adjoins the Yuba Extension claim of the Irelan Group ½ mile south of Chips Flat. L. D. Nihell and Jack Langman of Alleghany are the owners. An unknown but considerable amount of work has been done in years past upon the claim but much of this is now caved. The vein runs nearly east and west. Beginning within 100 feet of the east end line, a crosscut runs 400 feet to the vein and a drift westward on the vein is open 100 feet; total length of drifts each way unknown because of caves. The crosscut was extended 200 feet beyond the vein but is also caved. The vein fissure is said to show a width of 1 to 4 feet but does not carry pay where open at present, according to Nihell.

Osceola Group comprises Osceola, Osceola Fraction, Colorado and Yellow Jacket claims ½ to ¼ mile northeast of Alleghany by road and trail. R. G. Gillespie, Pittsburg, Pa., is the owner.

Nearly all the work has been done upon the Osceola claim. The lowest adit begins near the creek and is 1650 feet long, running through the Osceola claim into the Osceola Fraction. It follows the vein, the strike of which varies from N. 25° to N. 60° W. and the dip from 45° to 70° N. E. The vein varies here from 6 inches of gouge to 10 or 12 feet of quartz, and on the surface is even wider. At a point 125 feet from the portal, a winze has been sunk 75 feet; 75 feet farther and again 200 feet beyond that, other winzes of unknown depth were sunk. A dozen or more raises have been put up above that adit and one or two of these go through to the next level. Considerable ore was taken from these raises and a few adjoining stopes by Garnier, who also drove the next adit above. The three winzes probably mark the locations of three bunches of pay ore on which they raised and sank. There is an electric hoist and a skip at the first raise.

The second adit is about 200 feet vertically above the lowest and is about 300 feet long. The vein is up to 10 feet wide here. The highest tunnel is a crosscut 150 feet to the vein with a drift south 200 feet and north 75 feet. There is a winze 60 feet deep at the face of the south drift and a raise 90 feet to the surface.

The hangingwall of this vein shows a great deal of 'bluejay' and on the surface is altered to a rusty, oxidized mass full of quartz veinlets.

The total production of the property is stated to have been over $100,000, but the mine has been idle several years and no authentic details could be had locally about it. The two lower adits are accessible but the lowest one is in need of retimbering. There is a 9″ by 8″ compressor and 35-h.p. motor in a good building at the lower adit portal and a light 2-stamp mill stands exposed to the weather on the creek nearby.

Plumbago Mine comprises 8 quartz claims and a mill site extending diagonally southeast across Section 2 and into Sections 1 and 12, T. 18 N., R. 10 E., 31 miles by road from Nevada City and three miles by trail from Alleghany. Croesus Gold Mining and Milling Co. owner, 665 Fifth Avenue, New York. Leased with option to F. M. Ray, San Francisco. Hugh McCormick is the superintendent at the mine. This mine has been the biggest producer of the district. Its exact output is unknown and has no doubt been overestimated, but it has probably yielded about $7,000,000.

The Plumbago vein strikes west-northwest and dips 45° east as deep as followed. It lies in amphibolite and varies from inches to 18 feet in width, being pinched and without quartz on the west in most of the levels but is reported to be 18 feet wide on the east in No. 8 level. The outcrop was prominent and was worked extensively in early days.

Operations in later years have been through No. 4 tunnel, which is a crosscut 200 feet, then drifted west on the vein for nearly a mile. This tunnel is at an elevation of 3819 feet or about 700 feet below the outcrop. Nearly midway in it a winze has been sunk 650 feet on the dip of the vein, 45 degrees, and levels called 5, 5½, 6, 6½, 7, 8 and 9 have been drifted as follows:

No. 5 , east 600 feet and west 550 feet;
No. 5½, east 75 feet;
No. 6 , east 460 feet and west 760 feet;
No. 6½, east ___ feet and west 225 feet;
No. 7 , east 260 feet and west 600 feet;
No. 8 about 600 feet each way;
No. 9 about 300 feet each way.

Above No. 4, 'A' drift, elevation 3939 feet, and 'B' drift, elevation 4076 feet are expected to yield more ore.

The ore shoots pitch southeast, the largest at about 45 degrees. Beginning 200 feet east of the winze on No. 4 level, a stope was worked for a length of 350 feet on this level and was carried through to 'A' drift, where it was 450 feet long. From No. 9 level beginning near the shaft, another large shoot has been stoped through to 'A' drift. This is 250 feet long from the shaft west on No. 8 level; on No. 7 level it is partly stoped for 200 feet east and nearly all stoped for 300 feet west of the shaft, and on No. 5 it is stoped for 75 feet east and 275 feet west of shaft. The vein in this stope on No. 7 level was 4 feet to 7 feet wide. On No. 7 level beginning 400 feet west of shaft, a third shoot in which the vein was 3 feet to 6 feet wide, has been stoped partly for 150 feet up to No. 6.

As in the other mines nearby, the principal yield has been from bunches of free gold but the low grade ore often pays to mill. It carries pyrite with a little galena, zincblende and chalcopyrite.

The mine has a 20-stamp mill and its own electric power plant, run by water from the river and generating at full capacity 240 horsepower. Mine water has been used for milling. When visited September 20 the water had been pumped out as far as the No. 8 level and it was hoped that the mill could be started in a short time.

Rainbow Mine includes the Farnham Groves and Hanley patented claims and Belmont, Noble and Denver locations, extending about a mile southeast from Kanaka Creek across section 3 just south of Chips Flat. The vein was found in the fifties in an adit driven to prospect for gravel and was later found in two other adits 40 and 100 feet lower. The first mill of 8 stamps was built in 1858. From the lowest or Groves adit a winze was sunk 307 feet and stoping was done from this. A tunnel still lower, near the creek, was run later a total distance of 2300 feet including branches and a raise 481 feet connected with the Groves adit workings above, but pay was not developed in this lower tunnel.

The mine has been leased with option to the North Star Mines Co. They have been doing considerable work but report no particularly good results as yet. A winze has been sunk 330 feet on the vein from the lowest (Rainbow) tunnel and a level called No. 3 has been run 225 feet west and 250 feet east on the main vein. The vein is reported to be only a few inches wide here. There is also 400 feet of drift on a smaller vein which intersects the main vein 800 feet from the portal. Ferguson and MacBoyle describe the geology of the mine. The mill has been burned down.

Rainbow Extension adjoins the Twenty One claim on the south. A drift is reported to have been run 650 feet on what is supposed to be the '16 to 1' vein; in the footwall 150 feet distant, a vein called the Twenty One has been followed 250 feet, of which 130 feet is on the Twenty One claim and 120 feet on the Rainbow Extension. The prospect was not visited. The former vein is said to run from a few inches to 4 feet wide and to be pinched in the face of the drift.

Rising Sun Group comprises Monro, Rising Sun, Cedar and Baltimore claims on the west side of section 35, T. 19 N., R. 10 E., a mile by trail from Alleghany on the ridge between Big and Little Kanaka Creeks. Under lease to F. W. Nicholls, Alleghany.

The vein outcrops prominently on the ridge north of the workings. It is opened by a crosscut 185 feet long running N. 25° to N. 29° W. Near where this enters the vein the latter makes a turn and what is perhaps a branch has been followed for about 500 feet, S. 18° E. The vein does not outcrop on this side and is said to pinch near the face of the south drift, but this could not be verified as the drift is open only part way. There are 5 raises in this drift, two of them to the surface. In the north drift, the vein strikes nearly due north and dips 70° W. Where the crosscut enters the vein the hangingwall is broken and altered, showing 'bluejay.' The footwall is hard schist, well defined. A winze was sunk 24 feet and a raise put up 30 feet on the vein here, and the small area worked is said to have produced $12,000. There are indications here, confirmed by observations on the surface, that the main vein going south has not been opened, but lies nearly parallel to the crosscut. In the north drift the vein varies from 6 feet to 2 feet in width as far as the drift is accessible. This drift is said to be 300 feet long and could be cleaned out at small expense. There is a raise from it to the surface about 200 feet vertically above.

The property has been idle many years, and original records are not available. Assays taken from 100 feet of the south drift and 300 feet of the north drift at regular intervals are reported to have ranged from $4 to $30 a ton. Small bunches from the south drift yielded from $75 to $400 each. In the middle nineties a 10-stamp mill was built and a large sum was spent on a tramway to deliver ore from the mine to mill. This tramway is said to have been unsuccessful and the company failed. Only a little ore, which is said by a former millman to have yielded $6 to $8 a ton was crushed. The mill is still on the property.

Sixteen to One Mine. Original Sixteen to One Mining Co. owner, main office 607 Monadnock Building, San Francisco, H. U. Maxfield, president. M. C. Sullivan, manager at the mine. The property is just south of Alleghany and includes the Sixteen to One, Twenty-One, Happy Jack, Eagle, Belmont and other small fractions. The Twenty-One Mine was acquired after the lawsuit of 1919 which was won by the Sixteen to One Company. The latter has been in steady operation since 1912.

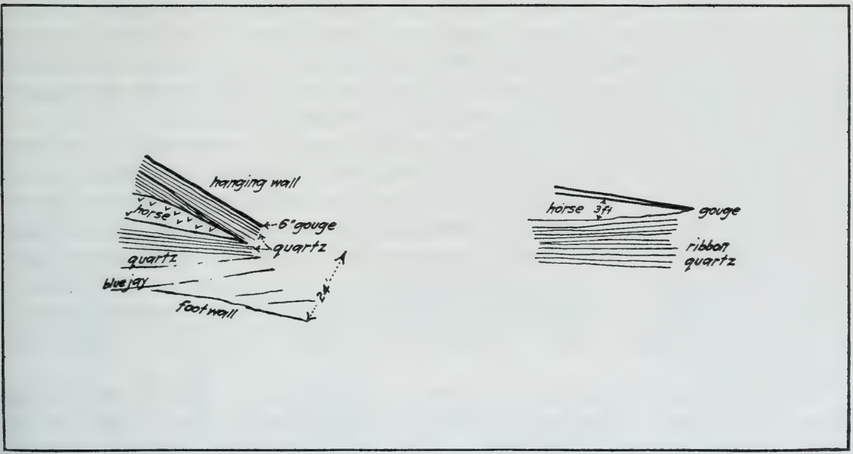
The Sixteen to One was originally opened by an upper adit from which a winze was sunk. During this work litigation arose with the Twenty-One Mine. A dispute also came up with the Tightner Mine about extralateral rights and to settle this latter a compromise line was agreed upon. This line is 850 feet from the Sixteen to One main winze at No. 8 level, but is not vertical its entire distance.

The working entry is called No. 2 tunnel; it is 1690 feet long and at an elevation of 4278 feet. The main winze to the lower levels is 600 feet from the portal of this tunnel and is equipped with a hoist capable of operating to a depth of 1500 feet. No. 2 tunnel is 107 feet below the apex. The winze gives an additional depth of 408 feet on the dip of the vein to No. 8, now the bottom level. Below No. 2 tunnel, the following drifts have been run:

100 level, 115 feet each way;
150 level, 60 feet north and 90 feet south;
200 level, 115 feet north and 50 feet south;
250 level, 650 feet north and 60 feet south;
No. 3 level, 960 feet north and 130 feet south;
No. 4 level, 740 feet north and 150 feet south;
No. 5 level, 950 feet north and 230 feet south;
No. 6 level, 1000 feet north and 90 feet south.

On the Twenty-One tunnel level, which is the same as No. 8, the Twenty-One tunnel is 1870 feet long to the main Sixteen to One winze, from which the vein has been drifted 850 feet north to the line, with 200 feet of parallel drift on the footwall.

In the '54' stope from the hangingwall drift on No. 8 level there is a vein 24 feet wide in the amphibolite schist, with 6 inches of gouge on the hangingwall and at times gouge on the footwall. The vein swells here and the country is badly broken up as occurs on the entry of another vein. The vein is quartz, well ribboned on the hangingwall side, with 'bluejay' prominent on the footwall and the aspect of the stope face when visited in September is shown by the sketches:



The vein strikes northwest and the dip varies from 30 to 70 degrees northeast. Besides the rich pockets and the milling ore, gold is found at times plastered on the mariposite but usually it does not go in. Many theories put forth to explain the reasons for the formation of the pockets and to prognosticate their location in advance, have come to grief. When the Twenty-One tunnel was being advanced by the Twenty-One Mining Co. and had reached a point 330 feet north of the present Sixteen to One main winze, it is said the company was watching for pay on the hangingwall side of the vein, as recommended by their engineer, but the miners, watching the footwall, made the discovery first. In a space 10 feet long by 40 feet high there on the footwall side, a pocket variously reported as containing $100,000 to $150,000 was extracted. Yields of proportional richness have been made in the mine during the past year. One report that received widespread notice stated that 50 feet of drifting with raises and stopes near the north line opened ore yielding $250,000 and the mine's output for the year is estimated locally at $750,000. The manager refuses to verify these reports and deplores their publication as being misleading. When rich spots are encountered he says they may or may not contain enough to pay for long periods of operations in low grade areas where the quartz is apt to carry $1 to $3 a ton, and the capricious occurrence of pay ore demands that this dead work be carried on.

In No. 1 stope at No. 6 level the vein is four feet wide, of well ribboned quartz with layers of 'bluejay' and considerable sericite mica, and with gouge on both walls. The immediate hangingwall here is black slaty schist.

The footwall of the vein in this part of the mine is everywhere intensely altered and broken up. It varies from greenish grey to nearly black, the latter color giving it the appearance of slate and being due probably to small amounts of graphite. The cross fractures and the cracks between the schist layers are filled with quartz and calcite and dolomite, the calcite being so common that every piece tested gave a pronounced carbonate reaction. This rock is undoubtedly the same as the 'bluejay,' except for the lack of the green mariposite. The hangingwall is similar to the footwall except for possibly less alteration. Horses of grey and black schist are prominent in the vein. The one shown in the sketch of the vein in the '54' stope is a black graphite schist, in places containing enough graphite to give a black streak on paper. Another slab from the hangingwall is an impure talc schist.

The quartz described as typical pocket rock is pure white, opaque, and without much visible ribbon structure. The average rock in the vein will not pay to mine and mill, according to Sullivan. The sulphide concentrate forms a small and unimportant part of the ore. From 1000 tons of ore milled 3 tons of concentrate worth up to $70 a ton may be obtained, and the concentrate product in three years is said to have been only 100 tons. In the No. 1 stope at No. 6 level the concentrate is said to be worth only $30 a ton and the average ore outside of pockets, $6 to $7 a ton.

The principal work now is near the compromise line in the stopes above mentioned. The vein is being stoped partly about 140 feet in length on the footwall side between No. 8 and No. 6 and the '54' stope is being worked in the same vicinity from the hangingwall drift. Between No. 6 and No. 5 three small stopes were worked. Between No. 6 and No. 4 for a distance of 170 feet north of the shaft the ground has been well stoped, with large pillars left. From No. 3 to within 100 feet of the surface has also been extensively stoped.

The policy of the management is to run to the line of the property and from there work back toward the shaft, cutting up the ground and retreating as it is worked. This is no doubt the best plan to follow. With all his experience, Superintendent Sullivan does not offer any hard and fast rule for finding rich ore, and states his belief that the best method is to carefully and systematically cut up the vein.

The property is well equipped and in good condition. Extensive additions are being made to the surface plant. A 10-stamp mill, crushing 30 to 35 tons a day is in operation. Machinery is on the ground for a new milling plant which will contain a Hendy ball mill and a Rexman balanced rod mill, which are expected to give a capacity of 100 tons a day. The ball mill will deliver a ¼-inch product to the rod mill which is designed to crush to 40-mesh. Outside amalgamation will be used. The ore is sorted and the high grade is crushed in Berdan pans. When the new mill is in operation the 10-stamp mill will probably be used for sampling. Power is obtained from the substation of the Middle Yuba Hydro-electric Co. located on the property. Seventy men are employed at present, but over half of these are working on surface construction, the average mine crew being 32 men.

Tightner Mine. Alleghany Mining Co. lessee with option to purchase. Main office 48 Mills Building, San Francisco, F. M. Searles, president. W. A. Simkins, secretary. The property includes the Contact, Contact Extension, Eclipse Extension, portion of Eclipse west of Kanaka Creek, Red Star Placer, Tightner Placer, Alene and Bartlett claims. Previous operations and the geology of the upper workings have been partly covered by H. G. Ferguson in U. S. Geol. Survey Bulletin 580, and in this Bureau's last county report. The lower section of the vein was opened by a crosscut adit 1265 feet long to the vein at an elevation of 4097 feet, thence continuing northwest over a mile as a prospect adit under the Red Star claim. Winzes, called North and South shafts, have been sunk on the vein below this adit. The South shaft is about 300 feet north of the compromise line between this mine and the Sixteen to One, and the North shaft is 700 feet from the South shaft. South shaft has reached a depth of about 1400 feet below the outcrop, or over 1000 feet below the tunnel and the North shaft is about 500 feet below the tunnel. No. 6 level in the South shaft is at the elevation corresponding with the bottom of the North shaft. In the South shaft, which is the present working shaft, the present company has sunk 330 feet and has driven the following new levels:

No. 4, 140 feet south and 90 feet north;
No. 5, 400 feet south;
No. 6, 300 feet south;
No. 8, 250 feet south;
No. 9, 60 feet south;
No. 10, 200 feet north;
No. 11, 70 feet north and 220 feet south.

Outside of mining that is going on above No. 6 level about midway between the shafts for a length of 75 feet and some possibilities of finding ore on 4 and 5 south of shaft, the mine is pretty well explored above No. 6 level, a length of 2400 feet out of 2720 feet of vein having been prospected. There is a barren streak in the vein between the shafts for a length of 500 to 550 feet, where the vein is small, usually only gouge. The north ore shoot was about 450 feet long, of which 100 to 150 feet on the north side was very rich. The ore shoots pitch south with the specimen ore in bunches.

On No. 11 level south near the line the vein is nearly five feet wide, strikes south to S. 20° E. and dips 22° N. E. The vein is formed of coarse ribbons of white quartz with bright green 'bluejay' on the footwall and a casing of a foot of soft slate on the hangingwall, with little gouge on the hangingwall and none on the footwall. The vein looks promising for pockets here, but so far is said to have yielded only a little coarse gold the size of wheat for a length of ten feet, where the vein pinched a little and the only other change noted was the coming in of small water courses. In the north face, horses in the form of small intermittent lenses of black slaty schist, heavily charged with pyrite, lay on the hangingwall.

Near No. 10 level is a small fault with three feet throw, above which there was some gold in the shaft, but none below. The vein steepens a little here. On this level the vein ranges from 6 to 14 feet wide. Some specimen rock was found near a small horse in the drift. In the face the vein is six feet wide, of coarsely ribbon-quartz, the black slate lenses of the hangingwall evidently furnishing the black layers in the vein.

On No. 9 south, the vein is six to seven feet wide, showing only a few zincblende crystals in the dead white quartz, and a little 'bluejay.'

On No. 8 level south the vein was smaller most of the way than above or below but began to bulge near the face. The vein becomes disturbed here and swells to a width of 30 feet for 40 feet or more above the level. No pay is reported from this level, but a high grade shoot comes down under this enlarged portion on the sublevel above. In this upper level a stope 20 feet long by 20 feet on the dip by 2 to 5 feet thick is said to have yielded $50,000. This narrow part shows a bad hangingwall with gouge. There was gold in a layer 3 inches thick next the gouge; from there it jumped down to follow another streak a little way, and so on. Its location near the swell in the vein led to the idea that its formation was caused by the approach of another vein. Such remnants of this pocket as were seen by the writer showed free gold without arsenopyrite. It should be remembered that this shoot is only a few feet from the area on the same level of the Sixteen to One Mine where the vein is 20 to 25 feet wide and heavy production has been made. When the Twenty-One Mining Co. came north in their tunnel they found a large pocket about 550 feet south of this place, and also on the footwall side. In their suit with the Sixteen to One Company the Twenty-One Company contended that they had been following their vein all the way, but lost the decision. The area intervening between these two rich pockets has since yielded rich returns to the Sixteen to One Company. No. 8 level in the Tightner has not been crosscut yet to determine the possibilities back of the main vein.

On and above No. 6 level north, ore said to mill $9 to $10 a ton is being stoped for 75 feet in length. The vein is being broken six feet wide, as it is said to carry pay for 4 to 6 feet next the hangingwall, which rolls and carries a six-inch gouge. The footwall shows the characteristic lenses of dark slaty schist. The quartz is well ribboned both parallel to and perpendicular to the vein walls, and there is a good deal of 'bluejay,' which is said to carry a little free gold, but most of the gold is in the mixed sulphides.

On the north above No. 6 the vein pinches. On the footwall there is a layer of talc, evidently derived from serpentine. There was no pay here. On No. 4 south the hangingwall is altered to dolomitic marble and 'bluejay' and the vein is 12 feet or more wide. The south stope from No. 8 to No. 4 was in high grade. The vein has never been crosscut here to determine its possibilities. Just north of the shaft and a few feet below the drain tunnel, the present company report taking out $50,000 in an area 25 feet by 30 feet, in a body of quartz lying on top of the main vein. The production by the present company has been about $600,000.

Besides the work in the Tightner proper, they have done over 1000 feet of new work in search of the Red Star vein, that is said to have been rich in the old shallow workings. The Tightner drain tunnel was extended over a mile by former operators in search of pay ore in this vein. The present company has put up a raise 400 feet and has done a good deal of drifting, but have not reported finding pay. The 20-stamp mill at the Tightner is in steady operation.

Wonder Mine consists of two claims, Wonder and Wonder No. 1. Owners, Flynn Bros. of Alleghany, H. T. Bradbury and Estate of J. Walsh. Leased with option in September, 1922, to Contact Mining Co. of Richmond, Cal.

The development work, done years ago, consists of a crosscut 200 feet west to the vein and drifts north 100 feet and south 75 feet. Sixty feet in the south drift a winze was sunk on the vein 60 feet deep and Wm. Walsh states this shows a 4 ft. ledge, but this was not verified on account of the winze being inaccessible. Work is to begin soon under the terms of the lease.

Bibliography: U. S. G. S. Bulletin 580 I, H. G. Ferguson. Colfax Folio, No. 66. State Mining Bureau, Mines and Mineral Resources of Sierra Co., 1918; State Mineralogist Reports, XIII and previous; Register of Mines of Sierra Co., 1903.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Tulare County.

The last full report on the mines and mineral resources of Tulare County was that resulting from field work carried on in June, 1916, and published as Chapter II, Part VI, of Report XV of the State Mineralogist, 1915–1916.

The county has since been visited by representatives of the Bureau in gathering data for Bulletin No. 76, Manganese and Chromium in California, 1918; and Bulletin No. 89, Petroleum Resources of California, 1921. It was also visited for the purpose of making a report on the magnesite industry of the State (unpublished), but no general revision of Report XV had been made.

For the purpose of bringing that report up to date and recording new activities in all branches of the industry, the writer spent about two weeks in September and October investigating present conditions.

Where inquiry developed the fact that properties were idle or remained in the same hands as previously reported, they were not investigated further. The following notes give such changes in ownerships as were found, new development, new deposits reported and the present activities of operating and producing properties.

Acknowledgments.

The uniform courtesy and assistance extended by owners and operators of mineral deposits throughout the county and by local Chambers of Commerce in assisting the writer to get in touch with owners is deeply appreciated. It is particularly gratifying to note that many of the latter bodies are giving attention to the mineral resources of their neighborhood, as well as to the agricultural opportunities to be found in this county.

Mineral Resources.

Tulare County is one of the largest counties of the San Joaquin Valley, having an area of 4856 square miles. The population (U. S. Census 1920) was 59,031.

The eastern boundary of the county follows the crest of the Sierra Nevadas and extends north and south for about 75 miles, embracing a series of the highest peaks in the United States, including Mt. Whitney (14,501 feet).

General Grant Park and Sequoia National Park are situated in the north-central part.

The eastern or mountainous area is composed essentially of the deep-seated granitic rocks, including granites, diorites, granodiorites and gabbros.

In the vicinity of Mineral King there is an exposure of heavy thick-bedded limestones and masses of dark silicious slates containing important orebodies. In the first foothills east of Exeter, Lindsay, and Porterville bodies of serpentinized peridotite occur associated with the granitic rocks and thin belts of limestone. In this area the principal magnesite deposits of the county are found. The western boundary of the county passes just east of Tulare Lake and the western portion is composed of nearly level sands, gravels and clays, of quarternary age. A small area near Ducor is composed of heavily bedded marine sandstones and diatomaceous shales, clay shales and gravels, of Tertiary age.

Tulare County has a larger area of watershed than any other valley county. It is drained in the main by the Kaweah, St. Johns, Tule, White, and Kern rivers.

Electric power is an important factor in the industrial life of the county. The Southern California Edison Company and the San Joaquin Light and Power Company carry a connected load of 85,000 horse power, with an unlimited supply available.

There are three hundred and four miles of concrete-base highway within the county, said to be the greatest mileage of concrete roadway of any county in the United States, and except for the remote mountain districts, transportation facilities are excellent, by both road and rail. Mineral King and Camp Nelson are the most easterly points that can be reached by automobile.

Tulare County's known mineral resources consist of antimony, asbestos, brick and tile, clay, chromite, coal, copper, feldspar, gold, graphite, gems, infusorial earth, lead, limestone, magnesite, manganese, marble, molybdenum, natural gas, quartz, glass sand, silver, soapstone, talc, miscellaneous stone, and zinc. The occurrence of tin ore has been reported, but not confirmed. Many of these deposits are little more than prospects at the present time whose commercial importance remains undetermined.

A number of wells are being drilled within the county in an endeavor to develop a commercial oil field.

Tulare County led the state in the production of magnesite for several years.

MINERAL PRODUCTION TABLE.

Year	Gold, value	Silver value	Brick		Gems, value	Granite		Magnesite		Stone industry, value	Miscellaneous minerals	
			M.	Value		Cubic feet	Value	Tons	Value		Amount and kind	Value
Total, including 1915	$402,569 00	$4,800 00	72,948	$517,171 00	$493,096 00	52,958	$92,460 00	76,315	$622,177 00	$43,051 00	[1]Various	$88,360 00
1916			6,330	$48,500 00				87,606	$737,130 00	$82,225 00	Chromite, 3,435 tons Copper, 1,422 lbs. Feldspar, granite, limestone, marble, silver	$42,555 00 350 00 36,410 00
1917				$112,938 00				136,562	$1,238,853 00	$75,594 00	Chromite, 450 tons Feldspar, 240 tons Tile, copper, granite, limestone and talc	$11,000 00 1,580 00 60,023 00
1918								28,826	$269,748 00	$125,407 00	Chromite, 600 tons Feldspar, 444 tons Limestone, 8,400 tons Silica, 204 tons Brick, tile, gems, granite, soapstone and talc	$24,000 00 2,928 00 32,400 00 1,143 00 71,782 00
1919				$34,978 00				18,765	$186,601 00	$10,811 00	Limestone, 10,347 tons Natural gas, 700 M. cubic feet Chromite, feldspar and granite	$46,388 00 295 00 51,928 00
1920								35,305	$394,169 00	$8,465 00	Natural gas, 400 M cubic feet Brick, feldspar, granite, and limestone	$195 00 190,467 00
1921								11,454	$125,594 00	$284,122 00	Limestone, 10,030 tons Natural gas, 380 M. cubic feet Brick and granite	$40,090 00 190 00 102,238 00
Totals	$402,569 00	$4,800 00	79,278	$713,587 00	$493,096 00	52,958	$92,460 00	394,833	$3,574,272 00	$629.675 00		$804,322 00

Grand total, $6,714,781 00.

[1]For details in previous years, see State Mineralogist Report XV., page 904.

MINES.

ANTIMONY.

No changes were noted in the status of the *Lady Alice Mine* at Mineral King, described in Report XV. Antimony occurs also on Redwood Mountain twenty miles east of Badger. It is undeveloped.

ASBESTOS.

There has been no development of the asbestos deposits mentioned in Report XV. Undeveloped deposits are also known on the Gill properties; Frederick Gill, Exeter, owner.

CLAYS.

The Pioneer Brick Company is no longer in business, and operations at Visalia have been discontinued.

S. P. Brick Company. W. D. Trewhitt, president, H. W. Shield, secretary and treasurer. Office 435 Rowell Building, Fresno, California. Plant located ¾ of a mile northwest of Exeter in Sec. 14, T. 19 S., R. 20 E. The deposit covers an area of twenty acres of which eight to ten acres have been worked. Since the last report, additional machinery has been installed and hollow building tile added to the output. Yearly capacity of plant 7,000,000 brick and 250,000 tile. Twenty-five men are employed. Operated one shift per day, with two shifts on the kilns, when burning. Tests have been made at the plant on clays from Hanford and other sources, a clay from Coalinga yielding an especially light weight brick of great strength. There is an increasing demand for hollow tile in the building trade, and the future outlook is reported as excellent.

CHROME.

All chrome deposits are idle, there having been no production since 1919. Most of the properties were formerly operated under leases that have since expired.

COPPER.

The properties mentioned under this heading in Report XV remain practically in the same state of development as then noted. All are at present idle.

A. P. Kirkland, Auckland, (Orosi P. O.) has one claim of twenty acres covering a copper and iron deposit located in Redwood Canyon. There is a road to the claim, good timber nearby, and water can be obtained from Redwood Creek. Very little development.

Copper showings have also been found in the vicinity of Three Rivers.

GEMS.

There is no activity in the production of gem materials.

FELDSPAR.

The production of feldspar in Tulare County has declined the last few years. None was mined during 1921, and the properties mentioned in Report XV are idle.

The following deposits have not heretofore been of record:

Jacobs Estate Deposit. Orthoclase feldspar occurs on the property of the I. H. Jacobs Estate. Henry A. Jacobs, attorney, First National Bank Building, San Francisco. The deposit is in T. 15 S., R. 25 E., Orange Cove being the nearest town and railroad shipping point.

Henley Feldspar Deposit. Owner S. E. Henley, 706 N. Bridge Street, Visalia, California. Property consists of eighty acres of deeded land situated in the Globe Mining District. Springville, three miles southwest is the nearest town. Porterville is twelve miles northwest, connected by paved highway. Property adjoins Globe siding on the S. P. branch line from Porterville to Springfield.

It is situated in the foothills at an elevation of 580 feet. There is no timber. Water is obtained from Tule River. The present owner has had the property since 1905. The deposit consists of a vein or ledge of high grade feldspar, which can be traced for a considerable distance, coursing NW.-SE., with smaller stringer veins. There is also an 8-foot quartz vein on the property. Development consists of an 80-foot tunnel. Two carloads of feldspar were shipped to Colorado four years ago. No equipment.

Harmon Deposit. W. P. Harmon, Stage Route No. 2, Porterville, California, has an undeveloped deposit of feldspar on his ranch near Springville. Judging from prospect holes put down, there appears to be a large quantity available. There is an overburden of a few feet of soil.

GOLD.

The White River Mining District, fifteen miles southeast of Porterville, is the only productive area where gold mining has been carried on to any extent in Tulare County.

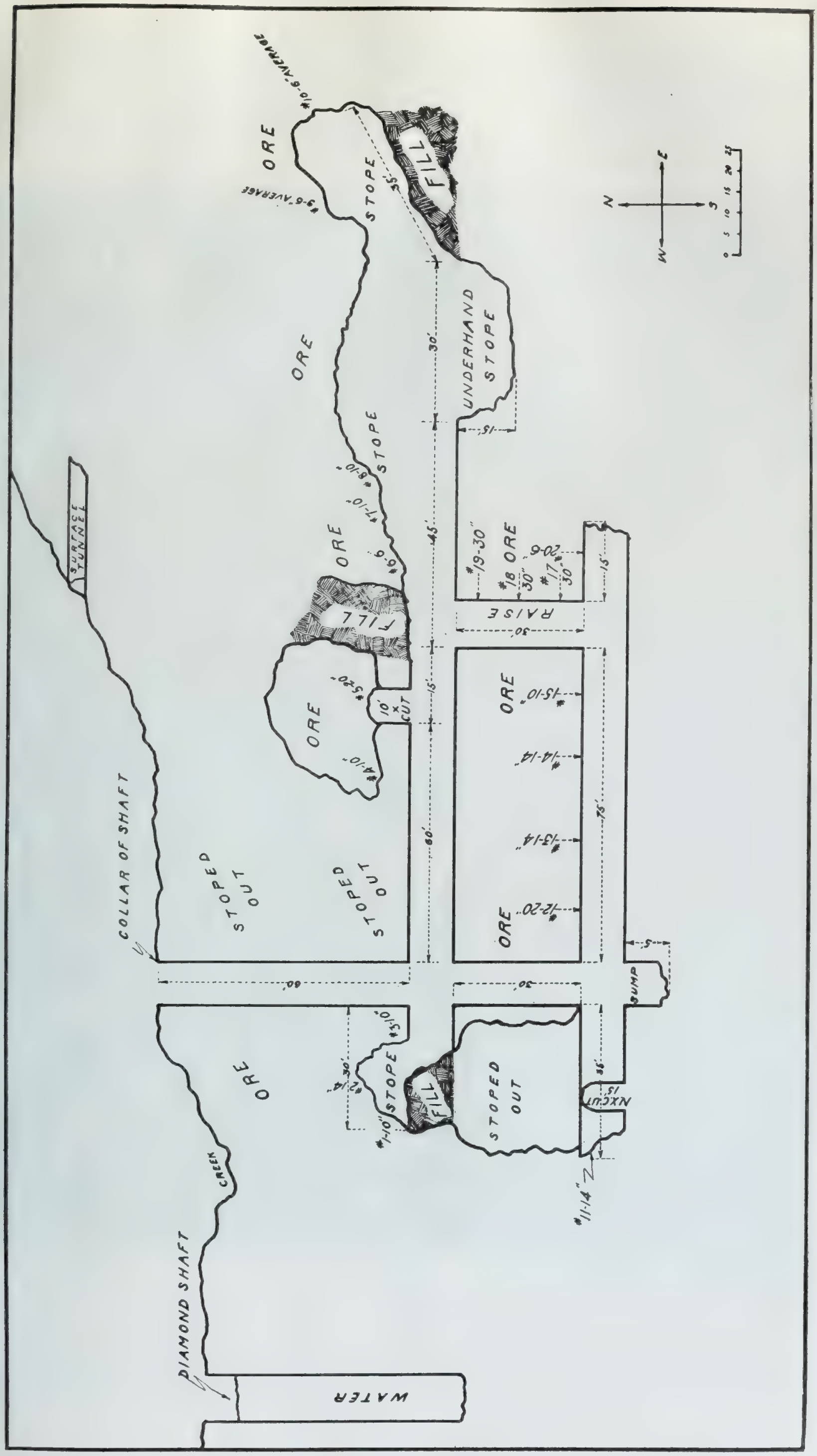
There has been a renewal of activities in the camp, the most important of which is the reopening of the *Bald Mountain Mine* by Warner Barnes & Co., (a limited co-partnership) home office, 1907 Chester avenue, Bakersfield, California. Copartners are Robt. Kendall, Porterville; M. Mitchell, Ducor; Edward Zalud and R. H. Barnes, White River; H. R. Warner and Roy Newberry, Bakersfield. Roy Newberry, secretary and treasurer, R. H. Barnes, general manager.

This company now controls the *Bald Mountain* and *Eclipse No. 2* mines.

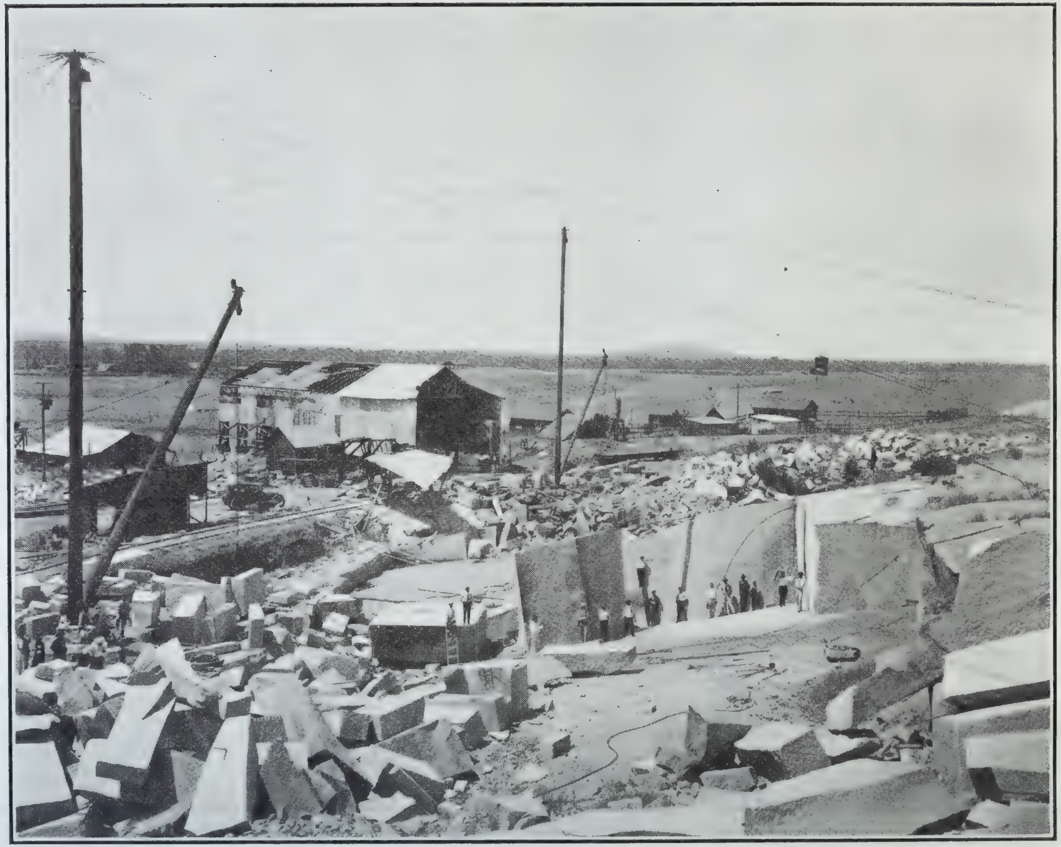
At present operations are confined to the Keys claim of the Bald Mountain property and to overhauling the mill and placing it in shape to run.

Old workings on the Keys Claim have been unwatered, the shaft cleaned out and retimbered and both drifts on the 60-foot and 90-foot levels cleared. A thorough sampling of the orebody indicated that a good grade of ore could be mined. On the 60-foot level a drift extends easterly along the vein for 185 feet. Considerable ore was stoped here, it being underhand stoped to a depth of fifteen feet toward the east end.

On the 90-foot level the drift has been run easterly on the vein for ninety feet. Seventy-five feet from the shaft there is a raise in ore to the level above. Both upper and lower drifts are being extended by the present company. West of the shaft the ore has been stoped out



Workings on Keys Claim, Bald Mountain Mine, Tulare County.



California Granite Company's Quarry, Porterville, California.

from the lower to the upper level for a distance of thirty-five feet, the length of the lower drift west. There is a considerable tonnage of ore blocked out by the present workings, and a complete sampling of the vein indicates good milling values.

The mine is equipped with a 15-h. p. Union gas hoist, good for 500 feet; a Rix 200-cubic-foot capacity compressor run by gas engine, complete blacksmith shop, ore bins, cars, etc. Nine thousand gallons of water is pumped daily.

Reduction equipment consists of 5-stamp mill (850-pound stamps) with plate amalgamation and No. 6 Wilfley table, all operated by 25-h. p. Fairbanks Morse gas engine. The ore is free milling. Seven men are employed.

The *Barton, Cherokee* and *Creeks* mines are idle.

At the *Florence G. Mine,* now owned by W. T. Young, E. S. Rowland, and P. McCluskey, preparations are being made to start operations. The ore will be handled by a 3-stamp mill and arrastra.

The *Homesake* and *Josephine* properties are idle.

At the *Last Chance* (*Redfield*) Mine there has been no development, other than assessment work.

The *Minnie Ellen, Stencil,* and *Sunset* Mines remain idle.

GRANITE.

California Granite Co., A. Pernu, president; A. M. Grindell, secretary, office 302 Builders' Exchange Building, 185 Stevenson street, San Francisco. This company operates quarries near Porterville and at Rocklin, Placer County.

Active operations have continued at the Tulare County quarry, described in detail in Report XV. The company has purchased fifteen acres including the ten acres formerly leased from C. A. Witt on the Success and Porterville road. Development of this tract has shown an excellent deposit of so-called 'black granite.'

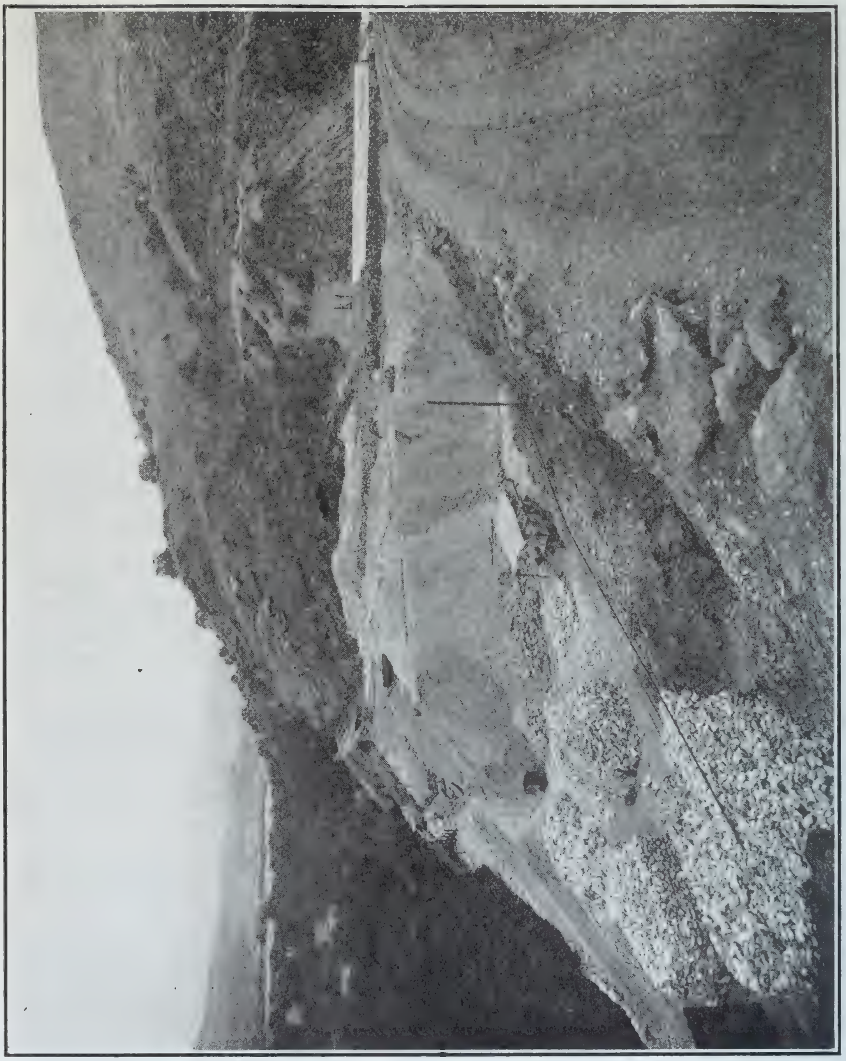
This rock is of exceptional beauty, and is especially desirable for monumental and decorative purposes, selling for $3.50 per cubic foot, compared to $1.80 for the light colored or gray granite.

The quarry is operated on the 'American Plan.' Twenty-five men are employed at present, but the number is being increased as fast as additional help can be secured. The company recently supplied the granite for the new Bank of Italy Building in San Francisco, and the management reports the future outlook to be excellent.

There has been no change of conditions at the *Rocky Point Granite Quarry* and it remains idle.

Dickey Property. There is a deposit of dark gray granite on the A. L. Dickey property in Sec. 11, T. 16 S., R. 25 E., about two miles east of East Orosi, at an elevation of 350 feet. It is practically undeveloped, but the U. S. National Bank Building in Dinuba is built of stone (largely float) from this deposit. There is no equipment. Total area 30 acres. A. L. Dickey, owner, Dinuba, California.

Conditions at the *graphite, gypsum* and *iron* properties described in Report XV remain unchanged.



Ore Dumps, A-South Opening, Sierra Magnesite Company.

LIMESTONE.

Kaweah Lime Products Co. This company controlled by A. C. Root of Fresno and C. A. Schafer took over in 1917 the property described in Report XV under the name *Lemon Cove Lime Quarry.* Home office, Lemon Cove; quarry and plant at Terminus, the end of the Visalia Electric Railroad. Operations have continued since 1917 with a production of from 90 to 175 tons of limestone per day. Considerable new equipment has been added and a new quarry face opened up. Air drills are used. Grinding equipment consists of a substantial mill building, housing two gyratory crushers, four Griffin machines grinding to two hundred mesh, and accessory machinery. The output consists of agricultural lime, paving dust and cement pipe stock. None of the limestone is burned.

Oat Canyon Limestone Deposit. Surface prospecting indicates the presence of high grade limestone lenses on the property of E. A. Orton, east of Lindsay. There is a siding on the Visalia Electric Railroad within four miles. The holding consists of 320 acres of deeded land lying in the foothills, at moderate elevation. Water can be developed. No production to date. Owner E. A. Orton, Box 41, Lindsay, California.

None of the other limestone deposits described in Report XV are being developed. It is reported that there has been some transfers of ownership of limestone-bearing lands in the vicinity of Three Rivers, and that the *Riverside Portland Cement Company* has acquired large limestone holdings on Cow Mountain near Springville.

The various deposits in this section have considerable potential value, although undeveloped at present.

MINERAL COMPOST.

Pennewell and Company, home office, Lemon Cove, are erecting a plant at Terminus adjoining that of the Kaweah Lime Products Company for the manufacture of a mineral compost composed essentially of lime, raw phosphate in the form of tri-calcium phosphate, and sulphur. The ground raw limestone will be supplied by the Kaweah Lime Products Company, and the other ingredients of the compost will be shipped in and combined into an indirect mineral fertilizer or soil corrective. The use of these minerals in farming operations is increasing in this state, and this product will no doubt find a ready market.

MAGNESITE.

Twenty-four magnesite properties in Tulare County are described in detail in Report XV, 1916. The production for that year was 87,606 tons of crude magnesite. In 1917 the production nearly doubled, amounting to 136,562 tons.

The magnesite industry declined rapidly in 1918, the production from Tulare County for that year being only 28,826 tons. There was a further decline in 1919, followed by an increased production in 1920, and then by a decrease in 1921 that brought the output of the Tulare County mines to the low figure of 11,454 tons.

The main hope for the future of this industry in Tulare County appears to be in the development of the plastic magnesite business.

The Tariff Act of 1922 places a duty on crude magnesite of $\frac{5}{16}$ of 1 cent per pound; caustic calcined magnesite, $\frac{5}{8}$ of 1 cent per pound; dead,

No. 22 Vein, Porterville Hill Property, Sierra Magnesite Company.

burned, and grain magnesite, not suitable for manufacture into oxychloride cements, $^{23}/_{40}$ of 1 cent per pound. On magnesite brick the duty is $\frac{3}{4}$ of 1 cent per pound and 10 per centum ad valorem. With the tariff question settled, the situation faced by California producers has cleared.

Since Report XV appeared there has been a number of changes of ownership of existing plants, properties, leases, etc., and a concentration of the former rather scattered mining activities into the hands of a few.

Blue Crystal Magnesite Mine. This property, which produced about 2500 tons of magnesite during the war, is now owned by S. A. Boggs and Fred Coolidge of Lindsay. Another claim has been acquired, making five in all, the Blue Crystal No. 1 and No. 2, Yellow Metal, Kaolin King, and Western Fraction.

Negotiations for the sale of the Blue Crystal to a Chicago company are under way. Included in the deal are two other deposits, one close to Strathmore, owned by Ed. Schrie, and another called the Apapha Mine, owned by J. W. Marshall. All are idle.

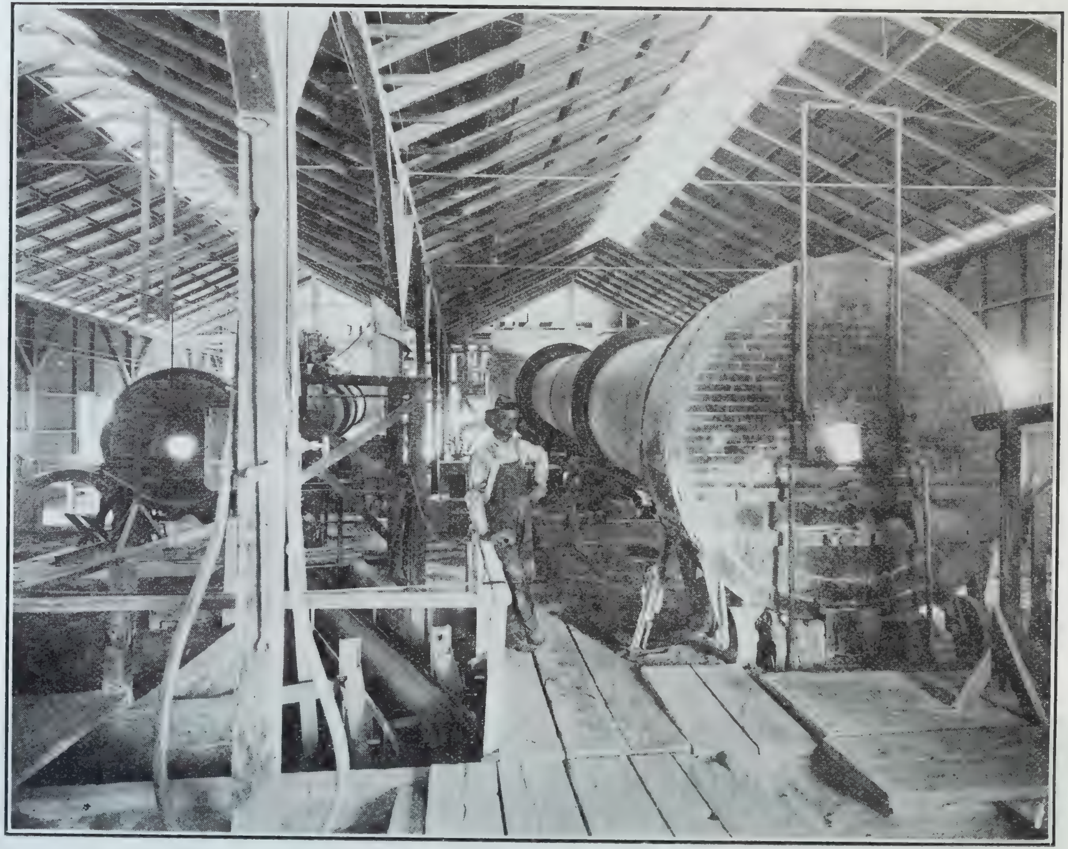
Sierra Magnesite Company (subsidiary *National Kellastone Company,* Chicago, Illinois), S. H. Barrows, president; J. A. Bernhard, vice president; C. H. Howse, treasurer; E. C. Tourje, secretary; offices, 404 Balfour Building, San Francisco; 155 E. Superior Street, Chicago, Illinois; 302 Park Row Building, New York and at Porterville. Arthur Deleray, manager, Porterville. The present company was organized in 1920 and has taken over the Tulare Mining Company property, leases formerly held by the Porterville Magnesite Company, and the Oakland Magnesite Company holdings. The calcining plant on the old Porterville Company property and that of the Tulare Mining Company are not in use, the Sierra Magnesite Company plant at the corner of E and Orange streets, Porterville, being the only calcining plant operating in the Tulare field.

The National Kellastone Company's plant is combined with this and a standardized magnesite produced. This is accomplished by the use of a Hoskins recording pyrometer for the exact control of furnace heat, and by the chemical and physical testing of all materials and finished products.

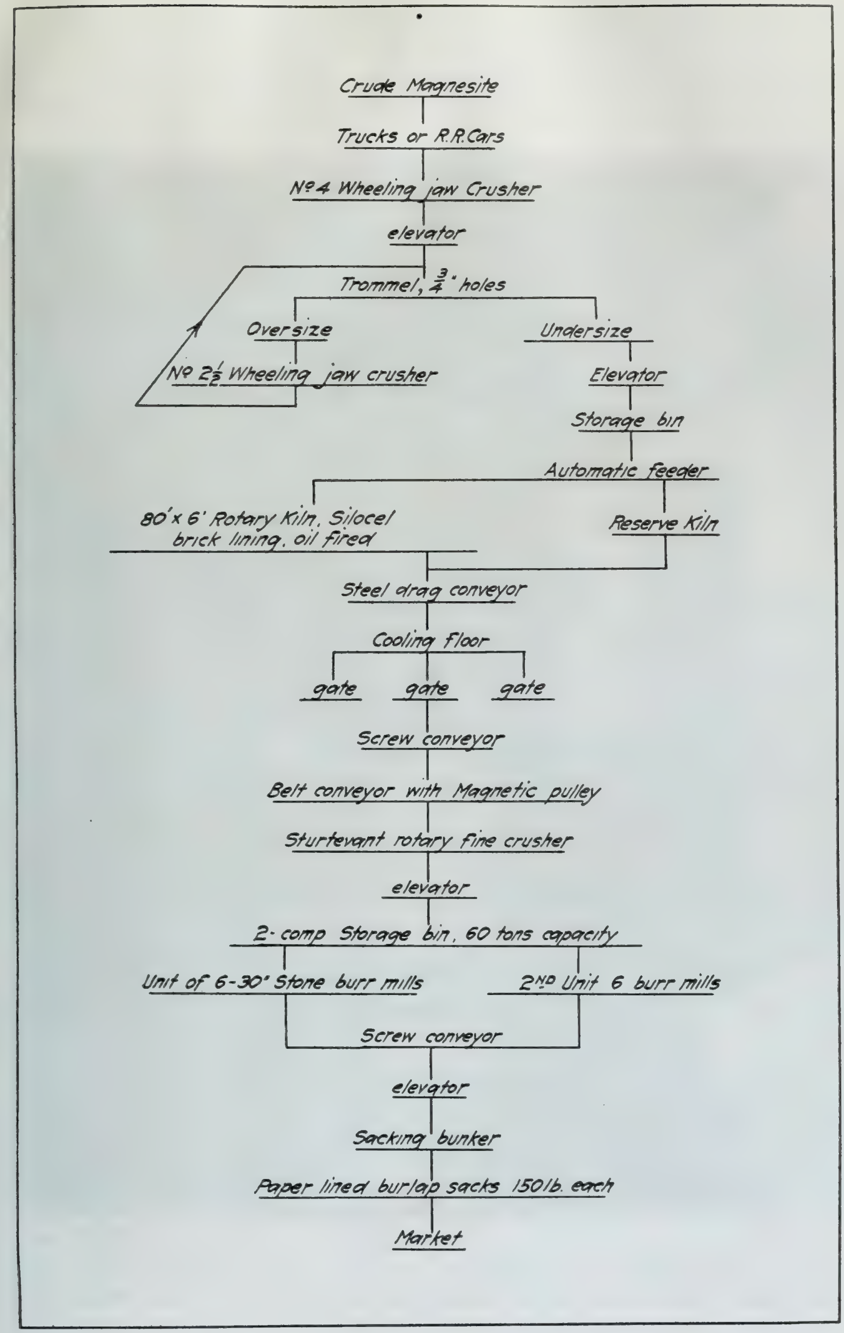
The company has its own magnesium chloride plant adjoining, for the manufacture of the solution used in mixing the 'Kellastone' stucco, composition flooring, drain-board material, interior plaster, wall board and other products.

Various colored rock 'dash' is used to give a variety of finish for exterior work. Difficulty has been found in locating a satisfactory yellow 'dash,' but reds, brown, pink, green, gray, and other colors are generally obtainable in the nearby foothills.

At the present time about one hundred men are employed. The Porterville Hill property is worked by contract. There are usually about twenty contracts going. All other properties are mined on company account. Sixty men are employed on the average in mining and thirty-five at the plant. A flow sheet of the mill is shown herewith. The entire plant is enclosed in a concrete and corrugated iron building with steel cooling floor. The chemical and physical laboratory and office building are finished on both the inside and the outside with Kellastone products.



Kilns Nos. 3 and 4—Rotary Calcining Ovens, Sierra Magnesite Company.


Crude Magnesite
Trucks or R.R. Cars
Nº 4 Wheeling jaw Crusher
elevator
Trommel, $\frac{3}{4}$" holes
Oversize
Undersize
Nº $2\frac{1}{2}$ Wheeling jaw crusher
Elevator
Storage bin
Automatic feeder
80' x 6' Rotary Kiln, Silocel brick lining, oil fired
Reserve Kiln
Steel drag conveyor
Cooling floor
gate
gate
gate
Screw conveyor
Belt conveyor with Magnetic pulley
Sturtevant rotary fine crusher
elevator
2-comp Storage bin, 60 tons capacity
Unit of 6-30" Stone burr mills
2ND Unit 6 burr mills
Screw conveyor
elevator
Sacking bunker
Paper lined burlap sacks 150 lb. each
Market

Flow Sheet, Sierra Magnesite Company's Calcining Plant.

Plunge, California Hot Springs.

One of the principal objections of architects and engineers against the use of magnesite plastic products in the past has been the lack of uniformity in the product marketed. This cause for complaint has been overcome by strict technical control of operations and the management reports the future outlook as especially good.

MANGANESE.

There is no activity in manganese mining. In addition to the localities mentioned in Report XV, manganese is reported to occur at points on Dry Creek about T. 15 S., R. 27 E. Undeveloped.

MINERAL SPRINGS.

Thirteen mineral springs are described in Report XV. No water is bottled at any of them. Probably the best known and one of the most accessible is *California Hot Springs.* Situated about 30 miles southeast of Porterville by good road. The property is owned by the California Hot Springs Company. Mrs. J. H. Williams, president; Joseph Mitchell, vice-president and general manager; Leo Mitchell, treasurer.

There is a large hotel and seventy cottages capable of accommodating 750 guests. Open the year round.

NATURAL GAS.

Natural gas has been known in the Tulare Lake district[1] for many years, but it has not been utilized commerically except for local domestic use on the several ranches. The gas occurs in water wells rising with the water, when pumped, or when they overflow, as a few do at certain seasons.

Southwest of Alpaugh the surface is higher than the general level of the land and a contour line here closes upon itself in the form of an ellipse whose major axis extends northeast and southwest. Locally this area is known as the island. Parallel with the contour line along the northwest side of the so-called island tract are the most numerous gas producing wells, but the gas is not limited to this area as it has been found and utilized at many other points in that part of southwestern Tulare lying west of the Santa Fe Railroad, and in Kings County.

These gas wells have not heretofore been mentioned in reports on the mines and mineral resources of the county, and for the purpose of placing them on record, this otherwise strictly agricultural and dairying section was visited.

Domestic Well, Alpaugh. This well supplies water for the Alpaugh Irrigation District and for domestic use in the town of Alpaugh. It is situated about half a mile south of the town. The well is 1200 feet in depth and is pumped continuously by a Layne-Bowler pump operated by electric motor. Pump discharge is through an 8-inch casing into an open concrete tank. The discharge pipe is raised at an angle so that although the pipe is full to within about one foot of the end, it does not carry a full 8-inch stream. At the lip there is a wedge-shaped open space extending back about one foot, the water at the lip occupying about three-quarters of the pipe end area. A lighted match applied to this open space above the water will immediately ignite the gas accompanying the water. It burns so clearly that the flame can scarcely be discerned when looking against the sky as a background. The quantity is not sufficient to make a very persistent flame of such large size, and a quick gust of air will blow it out. The gas is allowed to escape into the atmosphere and is not utilized. H. C. Rogers, manager, Alpaugh, California.

---

[1] See Summary of Operations, California Oil Fields, December, 1919, and July, 1922, for analyses of gas, etc.

Crowell Ranch Well. F. E. Crowell, Alpaugh, owner. The well on the Crowell Ranch about three miles southwest of Alpaugh is 1100 feet in depth. The discharge from the pump passes through a covered tank in which a portion of the gas collects. Enough is obtained for domestic use for cooking, lighting and heating. Most of the collecting tanks seen were small and as soon as filled to capacity the gas can no longer escape from the water but passes out into the irrigating ditches and hence into the atmosphere. There is a second well on the Crowell property, not now in use, at which the gas was formerly utilized for running the pump. Most owners prefer the convenience of electric power for pumping even when the wells supply sufficient gas to furnish the motive power for a gas engine.

Bent Ranch Well. On the Bent Ranch, J. W. McClarren, superintendent, Alpaugh. This property lies south of the Crowell Ranch. There are three gas producing wells on the Bent Ranch, but only one is utilized. It is 1100 feet in depth. A part of the gas that comes with the water is collected and utilized for cooking. A 1-inch pipe line supplies a 6-burner stove, but the owner says there is enough gas coming from the well to supply four such stoves. The gas burns with a clear blue flame said to be much hotter than one from manufactured gas.

Akes Ranch Well. Jess Akes, Alpaugh, owner. Property about ten miles southwest of Alpaugh. Gas from a well on this ranch is utilized to run the pump.

Golden State Property (Rising Ranch) Well. Owner, N. G. Rising, Los Angeles; Lessee, E. V. Elick, Alpaugh. One well 1100 feet in depth. Gas of the same character as that at the Bent Ranch is collected in a tank above the well and used for cooking and heating. When first put down there was a very strong flow of gas and the Rising Ranch Well was known, from its geyser-like blowouts of water and gas as the 'crazy' well.

Holland Dairy Ranch Well. Henry Lovin, Kingman, Arizona, owner; Jacob Sonke, Lessee, Alpaugh, California. There is one well on this property about 1200 feet in depth, with so much gas in the water that a turbine-type pump has to be used in place of a centrifugal. Gas allowed to go to waste.

Blaney Ranch Well. Mrs. N. J. Blaney, owner, 920 O Street, Fresno; T. C. Roller, Lessee, Angiola, California. There is one well about 1500 feet deep on this property. A tank over the discharge pipe collects a portion of the gas which is used for cooking, but most of it is allowed to escape. At certain seasons this well is artesian, and the gas comes with the water when it is overflowing as well as when being pumped.

Williams Ranch (Fulton) Well. Owner, R. Y. Williams, Santa Ana; Lessee D. H. Fulton, Angiola, California. Two wells are being pumped on the property, one 1800 feet and the other 2200 feet in depth. Gas is obtained from both and used for cooking. More is obtained than is used, and the owner states that he believes enough could be collected from the 2200-foot well to supply a small town.

California Natural Gas and Development Co., First National Bank Building, San Francisco, California. F. P. Kendall, president; Amos W. Elliott, secretary; R. N. Ferguson, superintendent, Angiola. This company is drilling a well for gas and oil about five miles southwest of Angiola just west of the Tulare-Kings County line, present depth 2200 feet. There are several other old wells on the property of the company and enough gas is being obtained to supply their needs in drilling.

Gas wells are also reported on the *E. L. Fox Ranch* four miles south of Angiola, on the *Tulare Farms property* and *Dan Gregg lands* south of Alpaugh, W. W. Galbreath, Alpaugh, manager of two latter properties; and on the *Canfield Ranch*, E. C. Percival & Son, Angiola, managers, but no details were obtained in regard to these.

In the same general vicinity, but farther north near Corcoran, in Kings County, there are a number of producing gas wells.

Sixteen or seventeen years ago there was a large gas blowout which destroyed the derrick at a well in Sec. 12, T. 23 S., R. 22 E., Kings County, and left a deep crater. There have been a number of wells at ranches along Dairy Avenue between Angiola and Corcoran, but some of these have ceased to produce gas. As a rule the gas ceases in from two to six years owing to the corrosion of pipes. Galvanized pipe is said to last longer than iron.

Burt Bros. Ranch. Owners, Burt Bros., Corcoran. Gas from two wells on this ranch is being used for cooking, lighting and heating, but more gas is wasted there than is saved, and the owner states that he believes the two wells would supply the town of Corcoran. The wells near Corcoran are much shallower than those farther south.

Hunter Ranch Well. Hunter Ranch, Corcoran, California. The gas wells here are shallow and usually not over two inches in diameter, being put down for the gas rather than as a source of water. At present one well 420 feet in depth is used, supplying gas for the cook-house. A good deal is wasted.

Hall Ranch Well. Hall Ranch, Corcoran, California. There are four 2-inch wells about 500 feet deep supplying gas for the cook-house. The quantity is diminishing as the pipes are getting corroded. These wells produce only a little water.

One mile south of the Hall Ranch there is a 4-inch well on unoccupied land that is a heavy gasser. No one is using it.

There is another gas well reported at the Clark and Becket Creamery, Corcoran. Not visited.

SILVER.

Deer Creek Silver Mine. This is an old property worked in the 60's or 70's, the ore at that time being hauled by wagon to Tipton for shipment to smelter. It was acquired in August, 1922, by the Deer Creek Silver Mining Company (unorganized), 1330 L Street, Bakersfield, California, and is being reopened. J. R. Hughes, superintendent. Terra Bella is the nearest town, and Magnolia Siding, 6 miles distant, the nearest rail shipping point. The mine is situated 11 miles southeast of Porterville at an elevation of 500-600 feet and is easily reached by good road. It is in an unorganized district but adjoins the White River Mining district. The company owns two patented claims and forty acres additional, making a total area of 80 acres. There is no timber. At present the mine makes about 250 gallons of water per minute.

The deposit occurs in a sheer zone about 150 feet wide, containing several parallel igneous dikes, and consists of a quartz vein system with talc gouge and cross veins. The principal vein so far developed is from six inches to 3½ feet in width. The lode can be traced on the surface for over a mile. Granite, the country rock, forms both foot and hanging wall. The vein strikes N.–S. and dips about 50° W.

The deepest working is an 80-foot vertical shaft which cuts the vein at that level. At a depth of 60 feet there is a 25-foot drift and 22-foot crosscut. From this level ore was stoped to the surface. On the 80-foot level there is a 75-foot drift run south from which some ore has been stoped. The ore carries silver sulphides, some gold, and about 6 per cent copper in the form of azurite. In places it is heavily mineralized and high grade. Present operations are of an explanatory character. Equipment consists of pumping plant, new head frames, and light hoisting equipment. A new incline shaft has been started on the vein. This is down 40 feet. From this shaft a crosscut is being driven into the footwall where it is expected to cut a parallel orebody. Four men are employed, two on top and two in the mine. Hand work only is used at present, but the company expects to install electric power.

This deposit is typical of many of the gold and silver properties in the granitic area of Kern, Tulare, Fresno and Madera counties. Many have good production records, but values are spotted as a rule, and the veins irregular and relatively narrow. Successful exploitation depends to a very great extent on a proper realization of these factors with the consequent reduction of 'overhead' costs to a minimum, and the elimination of expenditures for unnecessarily large reduction equipment.

ZINC-LEAD.

The old Mineral King district at the headwaters of the Middle Fork Kaweah River is the principal locality in which zinc-lead deposits are found. The ores usually carry gold, silver and copper as well, and are of complex character. Local attempts at treatment have been unsuccessful, and the inaccessibility of the district makes transportation very expensive.

Except for changes in ownership and annual assessment work, the mines remain in practically the same condition as stated in Report XV. To a company with ample capital and a thorough technical knowledge of the metallurgical problems, the district presents interesting possibilities.

Dolly Varden Mine. Idle. Owned by J. J. Davis, Mineral King, or Woodlake, California.

Empire Mine. Former owner, W. O. Clough, long interested in the district, deceased. Present owner, Arthur Crowley, Mineral King. Idle.

Monarch Mine. Owner, J. J. Davis, Mineral King. Formerly known as the Black Wolf.

White Horse Mine. Owned by Crowley and Davis, Mineral King.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Inyo County.

California Talc Co. This company has an option on a group of seven claims, as follows: Eclipse No. 1 and No. 2, Comet No. 1 and No. 2, Grant, Climax and Chieftain.

It has received a permit from the Corporation Commission to sell 75,000 shares at $1 per share par value, in order to purchase the above claims and erect a mill for the manufacture of talc and talc by-products. It is estimated a milling plant will cost, when erected, $25,000.

Kern County.

North Sumner. This property, described in the April number, is reported to have cut 4 feet of ore, assaying $41 per ton, in its lower workings. This is supposed to be an entirely new vein, and, should such be the case, it will mean much to the future of this mine.

Percy V. Long of San Francisco is president of the company.

RANDSBURG DISTRICT.

Yellow Aster Mining Co. The leasers, which the company has on its property, are taking out ore of an exceptional grade. From the Gunderson and Otterman lease $6,500 were the mint returns from 108 tons treated at the Yellow Aster mill.

While the company has had applications from many persons, but very few leases have been granted, and those only to first-class miners. By pursuing this policy the company will develop its holdings most advantageously and leave the mine in good condition for large scale operations in the near future.

MOJAVE DISTRICT.

Yellow Dog Mining Co. This company (to which reference was made in the July number of 'Mining in California') has just installed a 12″x10″ compressor and proposes to sink a double compartment shaft on its property near Mojave.

The Mojave district has to its credit production of several million dollars from such mines as the Exposed Treasure, Queen Esther and others, and it is to be hoped another mine of real importance may be developed by the Yellow Dog Mining Company.

San Bernardino County.

RANDSBURG DISTRICT.

Ben Hur. Developments have proven so satisfactory that larger equipment has been found necessary. The company has therefore installed one 10″x10″ Chicago Pneumatic Compressor, capacity 250 cubic feet. A. B. Hall is superintendent.

Black Hawk. Some months ago, this company put down a diamond drill hole, located several hundred feet to the east of the Bisbee shaft. Evidently the results obtained were encouraging, as it is now sinking a double compartment shaft in this region, which is down 100 feet. It has recently moved its compressor to this shaft from another part of its holdings, in order to speed up sinking. J. R. Greenan, manager; Dan McCormick, superintendent.

California Rand Silver, Inc. The following has been abstracted from the company's report for September:

"Dividend No. 33 for $25,600 was paid, being at the rate of 2 cents per share, and making a total of 70 cents per share since January 1, or a total of $896,000. Since organization $1.53½ per share, or $1,964,800 has been paid."

ORE EXTRACTION AND ADVANCEMENT.

During September, tonnage extracted was as follows:

Shipping ore	962	tons
Milling ore	4,312	tons
Waste	2,351	tons
Total extraction	7,625	tons

Advancements were as follows:

Drifts	1,163	feet
Raises	140	feet
Crosscuts	102	feet
Shafts	140	feet
Total advancement	1,505	feet

During the month, sinking of No. 2 shaft was resumed and it had reached a depth of 821 feet on the thirtieth of September.

MILLING OPERATIONS.

Except for a shutdown of virtually two days occasioned by an interruption in the Yellow Aster water supply, the operation of the mill was substantially as heretofore reported.

Total ore milled	4,391		tons
Daily average, 30 days	146.37		tons
Daily average running time	168.24		tons
Running time	26 days, 2½		hours
Lost time	3 days, 21½		hours
Average gold heads	$1 66		
Average silver heads	14 02		
Total average value		$15 68	
Average gold tails	$0 .41		
Average silver tails	93		
Total tails		$1 34	
Average gold extraction	75.30		per cent
Average silver extraction	93.36		per cent
Total average extraction	91.45		per cent

Recovery, per ton	$14 34
Total recovery on 4,391 tons	62,966 94
Average concentrate value	367 00
Tons of concentrates produced at $367	171.57
Tons of concentrates shipped, net	240

During the last days of September the new machinery designed to increase capacity to 200 tons daily was put in operation.

WATER SITUATION.

Late in the month the mine commenced pumping from the new Teagle Springs well, and is now being supplied with nearly 25,000 gallons daily from this source. The water is of high quality and materially improves the domestic water service of the mine.

In connection with the water situation, it should be noted that the water for some months present in the No. 2 shaft is increasing in volume, 114,000 gallons having been hoisted from this shaft in September. It is likely that the management will soon have to install pumps to handle the increasing flow. As all this water is used in milling operations, thereby lessening the amount purchased from the Yellow Aster Company, the increase of volume offers some compensation for the expense involved.

PATENT PROCEEDINGS.

During the month word was received from Washington that the Commissioner of the Land Office has denied the application of the Randsburg Silver Mining Company, owning the Coyote claim, for a hearing to investigate the mineral character and discoveries of this company's Uranium No. 7 and 10 claims. In other words, unless the Secretary of the Interior reverses this ruling, the only method of attacking this company's title to said claims will be through the courts.

During September 945 tons of ore (23 cars) and 240 tons of concentrates (6 cars) were shipped. We call attention to the fact that the mine since discovery has now shipped over 1000 cars of ore and concentrates.

Receipts from the smelter for September were $174,244.56.

After the payment of this dividend of $25,600, the company has on hand: $383,127.85.

Golden King United. This company controls ground in the region between the Sunshine and the Gimlet Mines. It is sinking an incline shaft on the vein and its present depth is about 100 feet. Its equipment consists of one 10″x10″ compressor capacity 250 cubic feet per minute, and one West Coast hoist driven by a 50–h. p. West Coast gas engine.

Housing accommodations for its employees are most modern in every respect. A few extra dollars spent in this respect will insure a contented crew and will be repaid many times by the increased efficiency resulting.

J. C. Topping is superintendent.

Grady shaft No. 1. This shaft, which is now down 1000 feet, is to be sunk 200 feet deeper. At a depth of 975 feet, a crosscut is being run, and it is reported that assays running as high as 25 ounces silver have been obtained. While no large or well defined ore body has as yet been encountered, it is nevertheless encouraging that some mineralized ground has been cut.

Silver Bell Mining Co. The Silver Bell claim of this company lies to the northwest of Uranium No. 3 owned by the California Rand Silver, Inc. The company has mapped out a very ambitious program, by proposing to sink a shaft to a depth of 1000 feet. Its equipment consists of one 12″x10″ Chicago pneumatic compressor having a capacity of 360 cubic feet per minute; one 50–h. p. Denver Engineering Company single drum electric geared hoist, having a hoisting speed of 600 feet per minute. The gallows frame is 40 feet high with self dumping apparatus. The shaft is 5′x7½′ in the clear and is now down about 150 feet.

The following are the officers of the company:

President: E. D. Burge; secretary-treasurer, Nat. Solomon; general manager, A. T. Johnson; consulting engineer, T. T. Lane.

Treasure Hill Mine: It is reported that the company operating this property will sink its present shaft to a depth of 525 feet. The property lies betwen the Ben Hur and the K. C. N. groups and has already developed ore of a commercial grade on its holdings.

OTHER DISTRICTS.

The old *Waterman Mine,* near Barstow, which was formerly worked by ex-Governor Waterman, is to be reopened.

Mr. George B. Parks has obtained a lease and bond on the property and is getting the workings in shape for active operation.

The property has a record of nearly 1,000,000 ounces of silver during the period that it was operated by Governor Waterman.

San Diego County.

Kerst & Regnier. A prospect carrying pockets of high grade ore is being developed by Kerst & Regnier at the Chase Ranch in the El Cajon Valley. Two shafts, one 48 feet, and the other 36 feet in depth, have been sunk on two stringers and assays from $75 to $300 have been reported on this ore. A small prospect mill is now at the property. If the present development proves the veins to be of a permanent nature, it is the intention of the present lessees to install a larger milling plant.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. COLLOM, State Oil and Gas Supervisor.

From September 16, 1922, to and including October 7, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well	Field
KERN COUNTY:					
Pacific Oil Co.	35	30	24	109	Elk Hills
Midway-McKittrick Oil Co.	30	30	22	2	McKittrick
Balboa Oil Co.	24	31	23	6	Midway
C. C. M. O. Co.	22	31	22	23	Midway
C. C. M. O. Co.	22	31	22	24	Midway
C. C. M. O. Co.	9	32	23	9	Midway
Caliposo Petroleum Co.	36	32	23	1	Midway
Honolulu Consolidated Oil Co.	6	32	24	59	Midway
Honolulu Consolidated Oil Co.	2	32	24	89	Midway
North American Oil Cons.	32	31	24	1	Midway
Pacific Oil Co.	27	31	23	29	Midway
Pacific Oil Co.	29	32	24	31	Midway
Pyramid Oil Co.	28	32	24	2	Midway
Standard Oil Co.	7	32	25	6	Midway
B. B. & O. Oil Co.	28	12	24	31	Sunset
C. J. Berry	34	12	24	11	Sunset
El Dora Oil Co.	32	12	23	5	Sunset
Lake View No. 2 Oil Co.	4	11	23	6	Sunset
Tannehill Oil Co.	34	12	24	24	Sunset
LOS ANGELES COUNTY:					
Black Star Oil Co.	30	4	12	Black Star 1	Long Beach
Bush-Voorhis Oil Co.	19	4	12	7	Long Beach
Calmont Oil Co.	19	4	12	3	Long Beach
Casa Blanca Oil Co.	28	4	12	Casa Blanca 1	Long Beach
Conductor's Oil Co.	29	4	12	Keyes 1	Long Beach
F. M. Couden	20	4	12	1	Long Beach
Dabney Oil Syn.	30	4	12	19	Long Beach
Dabney Oil Syn.	30	4	12	20	Long Beach
Duplex Petroleum Corp.	30	4	12	Weisz 1	Long Beach
Duplex Petroleum Corp.	30	4	12	Dahlia 1	Long Beach
E. & W. Oil Co.	19	4	12	1	Long Beach
Hugh B. Evans	30	4	12	1	Long Beach
Walter H. Fisher	30	4	12	2	Long Beach
Fred B. Foster Co.	20	4	12	Wallace 1	Long Beach
Graham & Loftus	19	4	12	1	Long Beach
Harmony Oil Co.	19	4	12	1	Long Beach
Hawthorne Oil Co.	19	4	12	1	Long Beach
Henderson Petroleum Co.	30	4	12	Nancy 1	Long Beach
A. T. Jergins Trust	19	4	12	4	Long Beach
Wm. P. Loftus	19	4	12	1	Long Beach
Lone Star Oil Syn.	30	4	12	1	Long Beach
Marine Oil Corp.	29	4	12	7	Long Beach
E. J. Miley	19	4	12	2	Long Beach
National Oil Co.	19	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Davidson 2	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Harlow 2	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Harlow 3	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Harlow 4	Long Beach
Regina Petroleum Corp.	27	4	13	1	Long Beach
Shell Co.	19	4	12	Marcellus 5	Long Beach
Shell Co.	29	4	12	Alamitos 5	Long Beach
Shell Co.	20	4	12	2	Long Beach
Shell Co.	19	4	12	Cresson 3	Long Beach
Shell Co.	29	4	12	Pickler 4	Long Beach
Shell Co.	29	4	12	Cherry Hill Com. 3	Long Beach
Shell Co.	29	4	12	Martin Com. 2	Long Beach
Shell Co.	29	4	12	Nicholson 2	Long Beach
Shell Co.	29	4	12	Wells 1	Long Beach
Simplex Petroleum Corp.	19	4	12	Garrison 1	Long Beach
Simplex Petroleum Corp.	19	4	12	Johnson, Duggan & Clark 1	Long Beach
Superior Oil Co.	19	4	12	Britton 1	Long Beach
Ticker & Johnston	30	4	12	1	Long Beach
United Oil Co.	19	4	12	Hass 2	Long Beach
Western Star Oil Co.	19	4	12	Campbell 1	Long Beach
Western Star Oil Co.	19	4	12	Neece 2	Long Beach
M. H. Whittier Co.	19	4	12	1	Long Beach
General Petroleum Corp.	8	4	14	Van Lew 1	Redondo

Company	Sec.	Twp.	Range	Well	Field
Standard Oil Co.	10	4	14	Torrance Com. 2	Redondo
Standard Oil Co.	8	4	14	Kirk Com. 1	Redondo
General Petroleum Corp.	5	3	11	Santa Fe 46	Santa Fe Springs
General Petroleum Corp.	6	3	11	Hill Midway 1	Santa Fe Springs
General Petroleum Corp.	6	3	11	Springs 4	Santa Fe Springs
Luneta Oil Co.	9	3	11	1	Santa Fe Springs
McKeon & Doyle	6	3	11	1	Santa Fe Springs
Pacific Petroleum Corp.	6	3	11	K-1	Santa Fe Springs
P. M. Pike	6	3	11	1	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Com. 3	Santa Fe Springs
Standard Oil Co.	5	3	11	S.Whittier Com. 5	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Com. 4	Santa Fe Springs
Stewart-Anderson Syn.	7	3	11	1	Santa Fe Springs
Superior Oil Co.	6	3	11	Wardman 2	Santa Fe Springs
Union Oil Co.	6	3	11	Bell 14	Santa Fe Springs
Union Oil Co.	5	3	11	Farwell 2	Santa Fe Springs
Union Oil Co.	31	2	11	Howard 4	Santa Fe Springs
Union Oil Co.	5	3	11	Meyer 8	Santa Fe Springs
Universal Cons. Oil Co.	6	3	11	3	Santa Fe Springs
Western Star Oil Co.	6	3	11	Weaver 2	Santa Fe Springs
Whiston & Cox Oil Co.	6	3	11	1	Santa Fe Springs
Wilshire Oil Co.	6	3	11	Gill 1	Santa Fe Springs
Mark L. Hawley	19	3	11	1-A	----------
Reider-Hoag Co.	34	1	17	1	----------
Frank P. Sproul	24	2	17	1	----------
NAPA COUNTY:					
Griffiths Oil Co.	29	8	3	6	----------
ORANGE COUNTY:					
George E. Cathcart	7	3	10	Toler 1	Coyote Hills
Standard Oil Co.	18	3	10	M. C. 94	Coyote Hills
Amalgamated Oil Co.	2	6	11	Hunt. Beach 4	Huntington Beach
Huntington-Downey Oil Co.	35	5	11	1	Huntington Beach
Miley Keck Oil Co.	2	6	11	20	Huntington Beach
Selby, Root & Hogue	34	5	11	Curtis 2	Huntington Beach
Selby, Root & Hogue	34	5	11	Clark 3	Huntington Beach
Shell Co. (U. D.)	14	6	11	Newland-Borchard 1-C	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 10	Huntington Beach
Standard Oil Co.	12	6	11	Gisler 1	Huntington Beach
Standard Oil Co.	12	6	11	Mills Land-Water Co. 1	Huntington Beach
Standard Oil Co.	12	6	11	Farnsworth 2	Huntington Beach
Union Oil Co.	35	5	11	Copeland 14	Huntington Beach
Union Oil Co.	34	5	11	Copeland 15	Huntington Beach
Union Oil Co.	34	5	11	Brooks 4	Huntington Beach
RIVERSIDE COUNTY:					
Arl Oil Co.	31	2	5	1	----------
SAN BERNARDINO COUNTY:					
Italian Vineyard Co.	26	1	17	1	----------
Western Pacific Oil Co.	4	10	4	1	----------
SAN MATEO COUNTY:					
Poso-Moon Oil Co.	10	6	5	1	Half Moon Bay
SANTA BARBARA COUNTY:					
Wm. F. Tobin	Lookout Park			4	Summerland
TULARE COUNTY:					
Josephine E. Neame Oil Co.	24	17	24	1	----------
VENTURA COUNTY:					
Montebello Oil Co.	4	3	19	Shiells 126	Bardsdale
B. & L. Oil Co.	4	4	18	1	Piru
Schell & Jennings	32	4	18	3	Piru
Ventura Petroleum, Inc.	25	4	22	14	Santa Paula
Progressive Oil & Ref. Co.	5	2	17	1	Simi
S-S Syndicate	6	2	17	2	Simi
South Santa Paula Pet. Co.	26	3	21		South Mountain

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

RADIOACTIVITY IN THERMAL GASES AT THE GEYSERS, SONOMA COUNTY, CALIFORNIA.

By WALTER W. BRADLEY.

The presence of radioactivity at The Geysers hot springs in Sonoma County was first noted by the writer[1] in the annual statistical report of mineral production two years ago. The statement referred to was based on the fact that one or two positive reactions had been obtained on February 22, 1920, with a rather crude arrangement of apparatus but the only equipment available on short notice at the time. Those tests were made on gases issuing from crevices in the side wall of the canyon of Sulphur Creek near the creek bed, at a point where the bank had been excavated and then covered by two rooms, with concrete walls, to be utilized for steam baths.

The main difficulty encountered in attempting to make the tests at that time was in getting rid of the considerable amount of steam accompanying the gas, as we had not suitable condensing apparatus at hand. The electroscope used was a homemade, single-chamber affair, provided with inlet and outlet tubes for the passage of the gas. The gold leaf was supported on an aluminum rod set in a sulphur plug. The principal objection to the single-chamber electroscope is the fluttering of the gold leaf and its possible damage thereby, in case the current of gas passing should be too strong.

Recently (Aug. 20, 1922) the writer made a second series of qualitative tests, assisted by Mr. Frank Sanborn, determinative mineralogist of the State Mining Bureau staff. The present owner of the property, Mr. J. D. Grant, has drilled two wells in the fumarole area on the north side of the canyon, opposite the hotel, at an elevation of approximately

---

[1] Bradley, W. W., California mineral production for 1919: Cal. State Min. Bur. Bulletin 88, p. 124, 1920.

1450 feet (barometric reading) above sea-level. The first well was not completed, as the casing collapsed on account of being too light. The second well (see photos A, B, and C) was put down with 12-inch casing to 106′, then an 8-inch inside of that down to 118′ 5″, from which point the hole was drilled in rock without casing. At the time of our visit the bottom was at 181′ 6″, but Mr. Grant informs the writer that it has since been drilled to 203′, at which point on breaking into another crevice (27 such crevices were broken into between 124′ depth and the bottom) the gas pressure became great enough to force the tools up the casing 12′ to 15′ and balance them there. They have decided to 'let well enough alone' so far as that one hole is concerned and will not try to go deeper, at least at present. These wells, and others to be drilled, are part of a prospective plan to develop steam power for an electric-generating plant, along similar lines to plants now in commercial operation in Italy.

With the top valve closed and the valve in the 8-inch horizontal pipe wide open, as shown in photo C, the steam gauge at the well showed 60 pounds pressure. With both valves closed, the gauge registered 70 pounds. A Brown expansion pyrometer indicated a temperature of 530° F. within the chamber of the top gate-valve while discharging wide open.

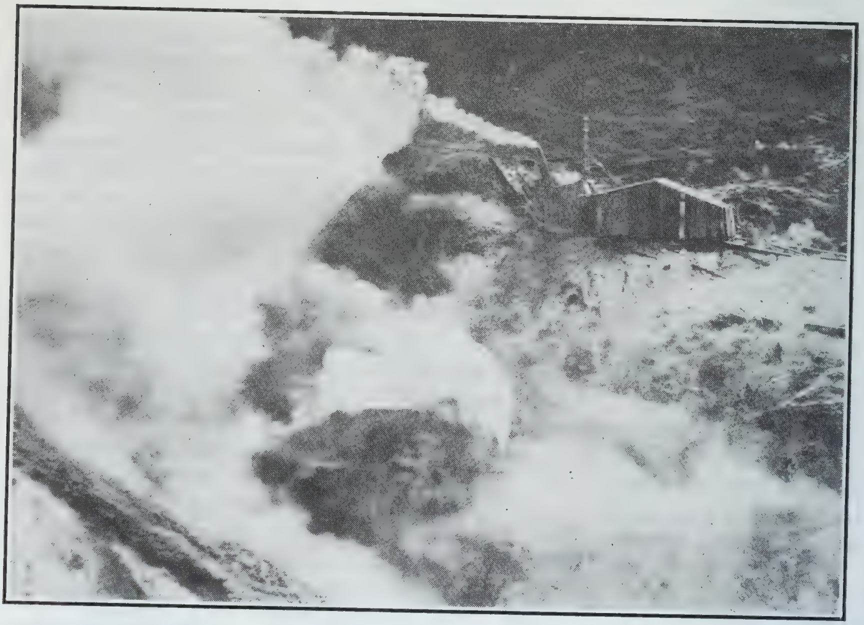


Photo A. Natural fumaroles, and well being drilled, at The Geysers, Sonoma County, California. Photograph taken early in the cool of the morning, when the steam shows more effectively. Photo by J. D. Grant.

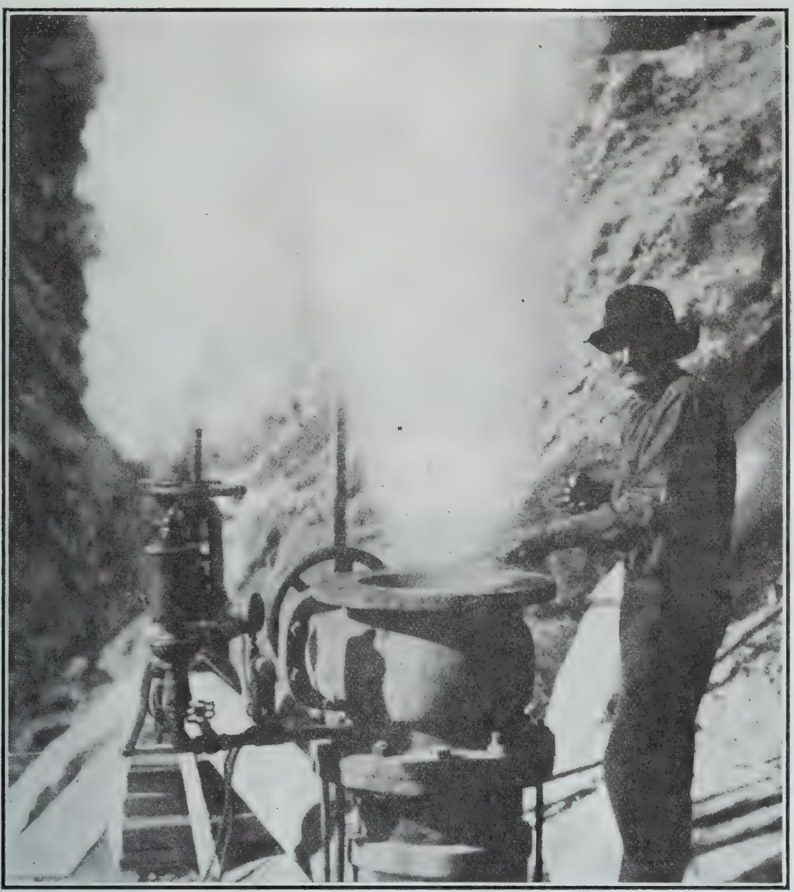


Photo B. Superheated steam issuing from well, with valve open. The thermometer registered temperature of 530° F. within the chamber of this valve. Photo by J. D. Grant.

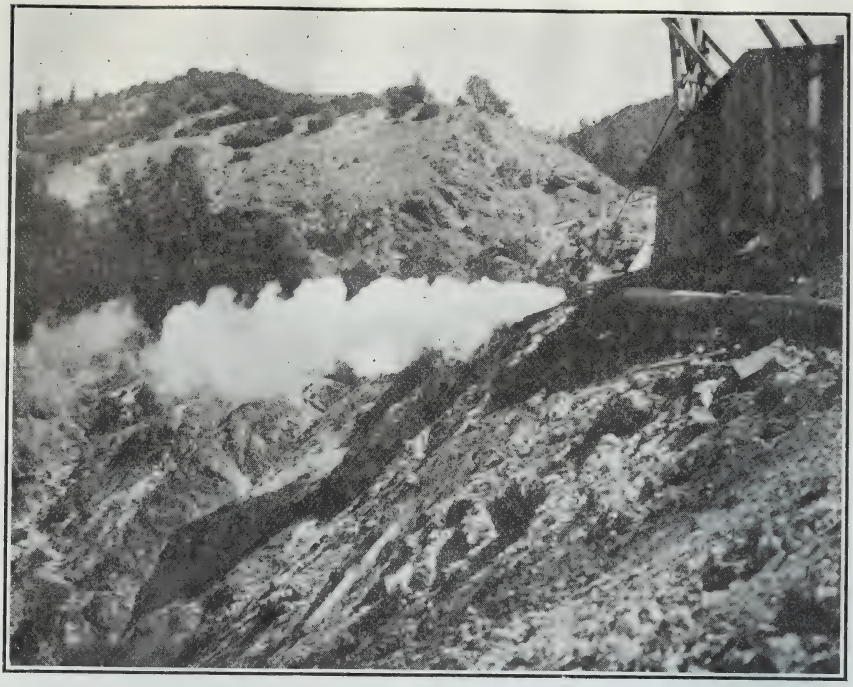


Photo C. Full head of steam issuing from 8-inch exit pipe at side of well, The Geysers, Sonoma County, California, August 20, 1922.

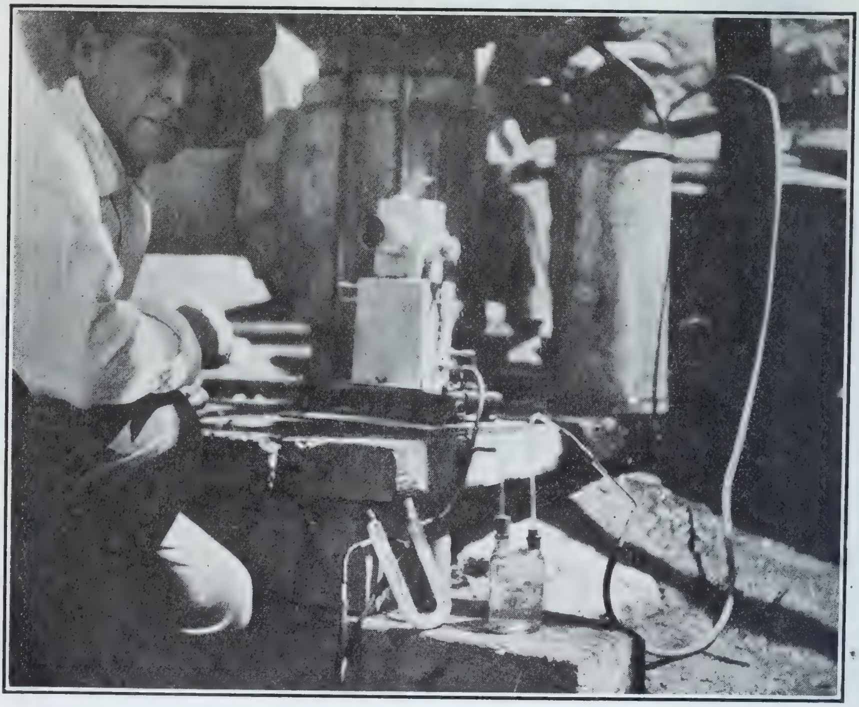


Photo D. Apparatus arranged to test radioactivity of gases at The Geysers, Sonoma County, California.

The electroscope used in testing the gas from this well for radioactivity is a two-chamber unit, constructed in the laboratory of the State Mining Bureau after consulting a number of text-books, drawings and authorities on the subject (see photo D). It is made of sheet copper, soldered, and the separable joints made air-tight with wax. The gold leaf in the upper compartment is attached to an aluminum rod which passes through a sulphur insulating-plug into the lower compartment.

Gas for testing was led off through a $\frac{3}{4}$-inch pipe tapped into the side of the well pipe and the valve in this smaller pipe barely 'cracked' open. The gas was cooled by passing through a tin coil condenser in a vertical cylinder (see photo D) with circulating cold water, and then into a Wolff bottle which collected such of the condensed steam as had not stopped in the tin coil. The gas was then passed through a U-tube filled with calcium chloride ($CaCl_2$) to completely dry the gas before it reached the electroscope.

Before introducing the gas, the gold leaf in the electroscope was first charged until it stood out at an angle of approximately 30° from the vertical. It remained in that position for 15 minutes without showing any appreciable air leak. (In the laboratory of the State Mining Bureau the leaf has repeatedly stood charged for as much as two hours without showing an appreciable air leak.) The dried gas was then allowed to pass through the lower compartment of the electroscope and the static electric charge on the gold leaf was completely discharged in 15 minutes. With the gas current still on, the leaf was then recharged; this time to an angle of 40°, and became completely discharged in 7 minutes.

The electroscope was then taken out of the circuit and removed to a point about 50 feet away from the well. The gas in the lower compartment was expelled by blowing air through, the stop-cocks closed, and the gold leaf charged to 40°. After 35 minutes the leaf had become discharged to 20°, indicating that the radioactive emanations had not been completely expelled from the chamber. The electroscope was again connected to the flow, and in three successive readings the gold leaf was completely discharged in 13 minutes, 12 minutes, and 9 minutes, respectively. A lighted match, held at the gas outlet to test the current flow, caused part of the gas to burn. This was due to methane and hydrogen, as shown by the following analysis, made for Mr. Grant on a sample of gas from this well by Smith, Emery and Company, San Francisco.

Analysis of gas from The Geysers:

	Per cent
Methane (CH_4)	2.9
Hydrogen (H)	11.2
Oxygen (O)	0.0
Carbon monoxide (CO)	0.0
Carbon dioxide (CO_2)	36.8
Nitrogen (N), and similar inert gases that may be present	49.1
Total	100.0

While making the above tests we suggested to Mr. Grant that he collect a gallon or two of the water condensed from the escaping steam, evaporate it to dryness and send us the residue for analysis. A few days later he reported to the writer that after evaporating three gallons of the water there was only a slight film of white powder on the side of the bucket, too thin to scrape off. One surprising feature of the above analysis is that it shows no sulphur, sulphur dioxide, or sulphuretted hydrogen, particularly as sulphur crystals are being deposited at many of the fumarole crevices in the vicinity of the well.

Although only a limited number of tests were made, the reactions were so positive and striking that there is no doubt as to the presence of radioactive emanations in the gas from this well. The results were qualitative only, but, with a proper standardization of the electroscope and volumetric measurement of gas samples, quantitative results can be obtained. For this we hope to find time available at some future date.

TERTIARY SLUICE ROBBERS.

By Chas. S. Haley.

From both the historical and the economic standpoint, the buried channels of what may be termed the Cretaceous-Eocene South Fork of the ancient river system which drained the major portion of the present American and Yuba rivers territory, are among the most important in the state.

From Yankee Jim on northwesterly, through Iowa Hill and Dutch Flat to its junction with the North Fork at Columbia, the course of this channel is well defined, and admits of little argument. From Yankee Jim east, however, there is a vast difference of opinion with regard to the correlation of this stream and its tributaries.

This is largely due to the change in drainage of the system which occurred toward the close of the Eocene period and contemporaneously with the earlier rhyolite flows. It seems undoubtedly to be the case that a large block of the western slope of the Sierras was tilted and dropped at this time, and comparatively abruptly; because a drainage was established toward the southwest, and approximately down the course of the present Middle Fork of the American, along lines which it retains to this day; although a gradual subsequent uplift during Quaternary time has altered the course of present day streams, and heavy erosion has taken place. Coincident with, and immediately following upon, this shift, new channels were cut. The flows of lava pouring down the western slope at intervals, in part following the old stream beds and in part obliterating them and transporting their contents to other courses; the dams of volcanic ash temporarily created and later released like tremendous 'self-shooters,' with all the volume of pent-up torrents behind them to cut new courses; and the comparatively quiescent periods between lava flows when the new streams pursued, perhaps for thousands of years at a time, new and wandering courses, distributing both new and ancient wash according as they were cutting lava or ancient stream beds; all of these influences combine to produce perhaps a unique condition, and certainly one of the most puzzling and complex situations with which the gravel miner has ever had to contend.

In working out this system, it is absolutely necessary to make one sharp distinction primarily; that between the tributaries of the old Cretaceous-Eocene, northward flowing stream, and those of the post-Eocene, southwesterly course.

In doing this, it is impossible to correlate exactly. Drainage lines as followed out may not have been contemporaneous by a matter of a thousand years, or even several thousands; but along broad general lines, it seems perfectly clear that the system is well established.

To begin with the pre-volcanic system. Following upstream from Yankee Jim through Forest Hill, Mayflower and Bath to Michigan Bluff, we have an important tributary coming down from the north which we may follow up through Gas Hill, Turkey Hill, Hidden Treasure and Sunny South to Damascus and Humbug Bar, with a tributary coming in by way of Red Point which may be traced below Westville clear up to the head of Secret Canyon. This evidently had a divided course at a later period, crossing over through Black Canyon and being joined by a tributary from Whiskey Hill, and later resuming its course near Westville. Another tributary to the Hidden Treasure branch came in by way of Deadwood. This in turn may be traced through Last Chance, American Hill and north of Antone Canyon up to Canada Hill and Sailor Ravine.

Coming back to the junction at Bath, we have the old Breece and Wheeler channel. For some distance this has been eroded; but in general it followed the Middle Fork to the Rubicon and up Long Canyon nearly to Wallace, where it crossed to the south side and goes through what is now Nevada Point to Little Grizzly; thence up Pigeon Roost to the eastern slope of Devils Peak, where it is very deeply buried under subsequent lava; thence through and across the upper portion of Long and Wallace Canyons to the northeast side of Jerry's Canyon, where it went through the Ralston Divide and its entrance may be seen above the Little Crater. From Jerry's Canyon on down another run of this same channel may be traced around Blacksmith Flat by way of the old Clydesdale over to the Nevada Point side, where it joins the old course. Following up from Little Crater, it crosses the Middle Fork to Duncan Creek, where it is joined by two tributaries; the Blue Eyes, coming down from Deep Canyon; and the Glen, coming down from Flat Ravine. Continuing north through the Hard Climb to Chalk Bluffs, it goes up the Middle Fork toward Castle Peak.

Again coming back to a junction southwest of Bath, we have another major fork. Crossing in a southerly direction near Volcanoville, we follow it upstream southeasterly toward Twelve Mile House and along the Georgetown Divide through Fornis Ranch, across Pilot Creek to Eleven Pines, and on the south side of the Rubicon through Uncle Tom's and thence easterly and northerly by way of Mount Mildred to Tahoe. A tributary comes from the southwest near Robb's Peak and joins this near the eastern edge of the Placerville quadrangle.

South of this area, we have tributaries running into another great stream, which was at this time the equivalent of the present South Fork of the American, with regard to territory drained. Commencing near the head of Rock Creek and also the head of Silver Creek we have two channels which drained southerly, and are almost eroded except for fragmentary patches until we get to White Rock Canyon and to Badger Hill, respectively. Their relation to the intervolcanic streams will be shown later.

Such was the general situation during Cretaceous and Eocene times. These channels had planed down the metamorphic rocks of the Sierras for probably a million years or more. In their beds was the source of most of the present day enrichment of the placers of this portion of the Sierras. Like gigantic sluice boxes they stretched their shining lengths over the rolling foothills of the Sierras, wending their way toward the northward flowing tributary of the Cretaceous Yuba, and contributing to the enormous masses of gravel already deposited in the glacier-hewn channels of what is now Quaker Hill and Blue Tent. Whenever these streams crossed a rich pocket and seam area, like that running northerly through Georgetown and Michigan Bluff, they were enormously enriched; but the heavy gold gained from these areas did not travel far, and hence these channels were, like those of the present day, extremely spotty. The fine gold was far more generally distributed.

The beginning of the era of intensive vulcanism is generally placed at the latter end of the Eocene period. The first manifestations of it were extensive showers of volcanic ash and pumice, which coated the flanks of the Sierras for many feet in depth. Probably the source of these eruptions can be traced to two or three vents; and from the present topography it is rather hard to estimate their positions. These vents covered the Cretaceous summit of the Sierras and its flanks for over a hundred miles in length with a mass of steaming mud and lava.

As the thick coating of ash was gathered up by the tributaries of the region, it collected in enormous masses along the main channels, causing them to dam up and change their courses. Then came the first flows of rhyolite, and a period of comparative quiescence for a few thousand years. New cement channels were formed, cutting the old ones and changing the drainage lines; but in general the course of the drainage was the same.

Next came the enormous eruptions of rhyolite and other acid lavas, together with the older basalts on the north. Pouring down the mountain sides in slow-moving masses, converting whole rivers into steam and causing tremendous explosions along their flanks and beneath the viscous masses, they cooled and solidified, raising the enormous rock masses that we now know as the Ralston Divide, the Nevada Point, and the Georgetown Divide, which were greatly increased in their relief by the later erosion of quaternary streams. Coincident with this came the dropping down of the area south and west of the present Middle Fork of the American. A new drainage to the ocean was established in a relatively short time; the then shore line being at the edge of the Sierras, and the diversion point being somewhere near the Dardanelles.

Intermittently, then, was created a whole new system of Tertiary streams, which may well be termed the sluice robbers of that and even of a later period.

The effects of this sudden change are well shown at Todds valley. Enormous masses of rhyolite lava, alternating with flows of steaming, viscid mud, tore down the old courses of the white quartz and metamorphic channels and picked up their contents bodily until, losing their grade and their momentum, they deposited them in this flat space. Quaternary erosion did the rest, the gold concentrated, and the result was the enrichment of Todds Valley. The gold originally lay in the channels of the old Cretaceous river; but these sluice robbers picked it up and redeposited it. Another similar drainage was established by way of Peckham Hill. Passing east through Volcanoville, we can follow another stream of this system which is joined by a tributary coming down the Ralston Divide. This latter picked up its enrichment from the crossing of the old channel near and below the Goggin diggings. Gathering some legitimate enrichment in crossing the pocket belt, but for the most part containing what gold it had taken from the older channel, this meets the Volcanoville Tertiary, which heads somewhere east of Bacchis. Together they form a larger channel which crosses Otter Creek to Gravel Hill and Jones Hill, and on into the present Middle Fork, where they were in turn eroded. At Jones Hill, or near there, this main channel is joined by another Tertiary stream which comes down from Seven Mile House through Bottle Hill. This also has another course through Three Mile House and southwest of the Georgia Slide, where it doubtless picked up some legitimate, primary enrichment. The Ralston Divide branch also had another tributary which later buried Nevada Point under a tremendous lava flow.

To the southward, via Kentucky Flat, Tiedemann's, and Tipton Hill, still further flows of volcanic mud and ash, as well as rhyolitic lava, poured down the Rock Creek drainage toward Placerville. Later, this channel, both in its Cretaceous and Tertiary form, was eroded by Rock Creek between Tipton Hill and White Rock canyon. A few traces of the gravel remain on widely separated points. The same condition was duplicated both as to formation and erosion by Silver Creek in the channel which came down from Eleven Pines by way of Mundy's and McManus to Badger Hill.

While these Tertiary channels may have accumulated a little gold for themselves, in the main they secured what wealth they have from their crossing and intermingling with the older Cretaceous drainage already described. In the main, they do not pay to drift, except near the sources of their enrichment; and often they do not pay to hydraulic. They are marked by a heterogeneous collection of quartz and metamorphic gravels robbed from the older streams, and by rhyolite boulders and ash, as well as intermittent solid rhyolite flows.

The principal one of these channels was undoubtedly the Ralston Divide-Volcanoville; and up near the Goggin diggings, where it more or less conformed to the old drainage, there was a fair, if somewhat spotty, gold content. Again at the Ralston pit, where it may have caught a northerly swing of the old channel over toward Brushy Creek, before the piling up of the main lava flow, and stripped the same, there appears to have resulted some enrichment. Again, west of Volcanoville, this channel has been enriched by crossing another of the old channels. This enrichment continues all the way to Jones Hill, where there was good hydraulic ground.

Wherever the modern rivers crossed and reconcentrated the Tertiary channels, there was little relative enrichment; but wherever they crossed the channels of the old Cretaceous system, as at Horseshoe Bar, the enrichment appears to have been the greatest.

NON-METALLIC MINERALS OF SOUTHERN CALIFORNIA.

By M. A. Newman.

There is no industry in California, and particularly in southern California, that is making the strides of the china clay industry, and whose future is more promising, due to our ever increasing population on the Pacific Slope.

The average prospector knows very little about the non-metallics and is just as apt as not to walk over a large body of clay in complete ignorance of its potential value. Neither the University of California, nor Stanford University, give any course in 'Ceramics,' so that even the mining engineers graduated from these institutions know very little about our non-metallic resources.

The following article on the china clay industry is being presented in the hope of being of some service to the mining public. As it is written by a man of years of experience in the china clay industry, we have no doubt it will prove so.

CHINA CLAY IN CALIFORNIA.

By Thos. Normile.

Part I.

Historical.

California is a land of wonderful opportunity as to its clay resources, and, as new deposits are discovered and located and their possibilities and usefulness studied for development, it is safe to say that California (and particularly southern California) will be very much in the lead as a producer of high-grade clays, or china clay, and will rank in first place with such states as Georgia, Florida, Tennessee and North and South Carolina; these states being large producers of china clays for a number of years, to the ceramic industries of the country, and to the paint and paper industries.

In regard to china clay (or kaolin), England has set the standard wherever the high grade clays are used, for the past 250 years, or ever since their discovery by Cooksworthy at St. Austall, Cornwall, in 1768. If civilization had started in the West and progress had moved eastward, who knows but what the clays of California would be the standard today, and not the china clays of England, for it is a fact not generally known that the first whiteware manufactured, of which record is made, was manufactured in Burlington, New Jersey, U. S. A., in 1685, by Dr. Daniel Cope, one of the Colonial Governors of New Jersey, and this ware was manufactured out of clay found in America.

In 1688, the works were inventoried and offered for sale, and published as follows:

> "I have erected a Pottery at Burlington for white chinaware, a great quantity, to the value of 1,200 pounds, has already been made and vended in the county and neighboring colonies and ye islands of Barbadoes and Jamaica, where they have been in great request. I have two houses and kilns with all necessary implements, diverse workmen, and servants. Have expended thereon about 2,000 pounds."

The above extract was taken from the 'Pottery Industry' also the following paragraph, which was taken from 'Pottery and Porcelain in the United States' by Edwin Atlee Barber:

> "A patent was taken out in 1744 by Edward Hylyn of the parish of Bow, in the county of Middlesex, Merchant, and Thomas Frye, of the parish of West Ham, in the county of Essex, Painter, for the manufacture of chinaware and the following year they enrolled their specifications, in which they state that the material used in their invention is an earth, the produce of the Cherokee Nation in America, called by the nation 'unaker.' "

The information contained in the above two paragraphs quoted will no doubt be a surprise to many pottery and clay men, who are not already acquainted with this fact, and who are of the opinion that china clay and the whiteware pottery industry was started in England, before it was in America, but as previously stated it was twenty-four years later before china clay was first discovered by Cookworthy in 1768.

Josiah Wedgwood wrote of a pottery that was established in South Carolina, U. S. A., in 1765, that was operated by workmen from England, and ''having one of our American master potters to conduct them.''

The most important districts producing china clay today in America are the southern states already mentioned, Georgia, Florida, Tennessee, and North and South Carolina, and California, and the least known of these districts is California, for it is only the past few years that china clay was prospected for to any extent.

The writer has a personal knowledge of a china clay in California that was first discovered over thirty years ago. Samples of this clay were sent to various potteries in the East, and also to Germany and England, and, wherever it was tested and its finished samples exhibited, it was pronounced about the finest china clay ever found. A chemical analysis of this clay made by Dr. Frank K. Cameron of Washington, D. C., shows on analysis 66 per cent silica (SiO_2) and 22.8 per cent alumina (Al_2O_3), the difference from 100 per cent being mainly water, with only a very faint trace of iron, which positively does not show in the firing. This composition shows a somewhat higher ratio of alumina to silica than in the theoretical kaolin of 46.3 per cent silica, and 39.8 per cent alumina, balance 19.9 per cent water.

This clay is a very desirable clay for manufacturing all kinds of whiteware, such as general ware, sanitary and electrical porcelain. It is known today as the 'Lost Clay' and will be on the market in the not too distant future. I may also add that this 'Lost Clay' will be of exceptional value to the paint and paper trade, especially on the Pacific Coast, due to its plasticity, freeness of grit and whiteness under water.

This 'Lost Clay' deposit was first discovered in 1884 and has been very much sought after ever since. The original discoverer of this wonderful deposit of clay, after sending samples of it broadcast throughout the East, including Germany and England, very suddenly died. Two years ago, this long-lying dormant deposit was rediscovered by the writer, by accidentally finding a sample of the clay on which the original discoverer had carved his name, date and location, in 1884. The reading on this old sample of clay is still discernible, and is considered quite a curio by the owner. This old deposit would be working now, but the parties now interested are desirous of securing some adjacent property that will facilitate the working of the clay property. This wonderful clay will be selling on the market within the coming year.

California has some very plastic china clays, some of them extremely so, which makes them adaptable in the manufacture of table ware, sanitary ware and electric porcelain.

The uses of clay are many and varied, and new ones are being found constantly.

Clay is one of the most widely distributed minerals, and a little more cooperation among interested parties would help materially.

The California State Mining Bureau has made vast strides in the past few years in clays, and all non-metallic minerals.

The State Mining Bureau, in January, 1920, issued Preliminary Report No. 7, entitled the 'Clay Industry in California,' that is a very good guide to the prospector and others interested in looking for clays, and, on page 13, under 'Field Examination,' they will find some valuable information that will be of great assistance in this interesting work.

A Department of Ceramics in our State University at Berkeley and Los Angeles would be a great asset in helping with the physical and chemical analysis needed in the testing of the various clays that are almost daily being sent in from the mountains and deserts of the Pacific Coast states.

In England, years ago, when the clay industry was somewhat more or less of a problem, the Government pooled its interests with the people interested, and the results are well known.

What is needed in California at this time is a plant for the washing of china clays. The writer knows of deposits of good white clays, suitable and adaptable for the paint, paper and pottery trades, but they need washing to eliminate the impurities they now contain, such as free silica, mica, pyrite and limonite. Hardly any one company is large enough at this time to make a sufficiently comprehensive research of this industry on this coast.

Present Operators and Products Manufactured.

The manufacturing concerns in California today that are users ot high-grade white burning china clays in the ceramic industry are the following:

The Pacific Porcelain Ware Company is operating two plants. It has a six-kiln pottery at Richmond, California, and a five-kiln pottery at San Pablo, California.

The West Coast Porcelain Company, at Millbrae, California, has a six-kiln pottery.

These two very progressive concerns are manufacturing a complete line of sanitary ware, and are credited, today, with making the best line of sanitary ware made in the world, and they are both users of California clays.

The Homer Knowles Pottery Company, located at Santa Clara, California, is making a general line of hotel and dinner ware. They are using some local clays.

The Empire China Company, at Burbank, California, is operating a seven-kiln pottery, and is making a complete line of hotel and dinner ware. This concern is using local clays, getting their china clay from their own large deposit in Lincoln County, Nevada.

The Mission Potteries Company, at 652 Griffin avenue, Los Angeles (formerly the Standard Pottery), is operating a three-kiln plant and is manufacturing a line of hotel ware and at present is using some foreign clays, but in the near future will operate with all local clays, exclusively.

The China Products Company, located at 2300 East Fifty-second street, Los Angeles, has a three-kiln pottery. This company manufactures a line of hotel and dinner ware, and is using all local clays.

The American Encaustic Tiling Company, located at 5200 Alameda street, Los Angeles, is operating a nine-kiln pottery, and is manufacturing a very high grade of floor, wall and mantel tile. This large concern is also using local clays.

The T. C. Prouty Pottery Company, located at Hermosa Beach, is manufacturing low potential electric porcelain spark plugs and white floor tile. This new concern, after a few years of experimenting with all kinds of clays, is using California clay almost exclusively.

There is at the present time under construction a large plant being erected by the Whiting-Mead Company of Los Angeles, on its 38-acre industrial tract, to manufacture a complete line of sanitary ware. This concern is going to use the Russell type of twin continuous kilns, three hundred and sixty feet long, built by the Russell Engineering Company of St. Louis, and is also going to use local clays.

(To be continued.)

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coördination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau Publications have been made available for distribution:

Summary of Operations, California Oil Fields, June, 1922, Vol. 7, No. 12.
Mining in California, August 1922 (Monthly), Vol. 18, No. 8.
Oil Field Map, No. 8, South Midway and Buena Vista Hills.
Oil Field Map, No. 9, North Midway and McKittrick.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XIV, State Mineralogist	6
Report XV, State Mineralogist	1
Report XVII, State Mineralogist	3
Mines and Mineral Resources of Colusa, etc.	1
Mines and Mineral Resources of Del Norte, etc.	4
Mines and Mineral Resources of Fresno, etc.	2
Mines and Mineral Resources of Imperial, etc.	3
Mines and Mineral Resources of Alpine, etc.	2
Mines and Mineral Resources of El Dorado, etc.	1

Publications	Number distributed
Mines and Mineral Resources of Los Angeles, etc.	1
Mines and Mineral Resources of San Bernardino, etc.	2
Mines and Mineral Resources of Nevada County	2
Mines and Mineral Resources of Plumas County	3
Mines and Mineral Resources of Sierra County	4
Bulletin No. 6, California Gold Mill Practices	3
Bulletin No. 37, Gems, Jewelers' Materials and Ornamental Stones of California	4
Bulletin No. 50, Copper Resources of California (Revised)	1
Bulletin No. 72, Geologic Formations of California	11
Bulletin No. 75, United States and California Mining Laws	35
Bulletin No. 76, Manganese and Chromium in California	1
Bulletin No. 78, Quicksilver Resources of California	10
Bulletin No. 85, Platinum Resources of California	6
Bulletin No. 89. Petroleum Resources of California, with special reference to unproved areas	36
Bulletin No. 90. California Mineral Production for 1920, with County Maps	1
Mining in California (Monthly), Vol. 18, No. 7, July, 1922	2650
Summary of Operations, California Oil Fields (Monthly) Vol. 7, No. 12, June, 1922	2750
County Maps and Registers of Mines	3
Copper Deposit Map	3
Inyo County Geological Map	4
Minaret Map	1
Tuolumne County Map	1
Geological Map of California, mounted	16
Map accompanying Bulletin No. 89	37
Lake County Map	1
Oil field maps	397

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 793 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Statistician and Curator.

STATISTICS.

MINERAL PRODUCTION OF CALIFORNIA IN 1921.

SECTION SEVEN —— BY COUNTIES.

Introductory.

The State of California includes a total area of 158,360 square miles, of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum, 148 miles; and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. Minerals of commercial value exist in every county, and during 1921 some active production was reported to the State Mining Bureau from all of the fifty-eight.

Of the first ten counties in point of total output for 1921, the first five (Kern, Orange, Los Angeles, Fresno, Santa Barbara) owe their position mainly to petroleum, as does also Ventura (seventh). Kern, due to its oil, leads all the others by over twice the total of Orange, its nearest competitor. San Bernardino owes its place chiefly to cement, silver and borax; Riverside to cement; Yuba to gold; Santa Cruz and Solano to cement. Twenty counties have each a total in excess of a million dollars, for 1921. Cement is an important item in six of these counties. In point of variety and diversity, San Bernardino County led all the others in 1921, with a total of 23 different mineral products on its commercial list, followed by Los Angeles and San Diego with 14 each; Inyo with 13; Kern and Shasta, 12 each; Riverside, 11; Fresno, 10; Santa Clara, 9. The counties with their mineral resources, production for 1921, etc., are considered in detail in the following paragraphs.

Value of California's Mineral Production by Counties, for 1921. Arranged in the Order of Their Importance.

County	Value	County	Value
1. Kern	$100,840,933	16. Contra Costa	$1,622,732
2. Orange	47,499,030	17. Calaveras	1,525,201
3. Los Angeles	31,704,941	18. Inyo	1,460,218
4. Fresno	19,498,503	19. San Benito	1,386,093
5. Santa Barbara	10,190,929	20. Alameda	1,353,690
6. San Bernardino	9,375,540	21. Shasta	841,062
7. Ventura	6,245,269	22. Santa Clara	750,708
8. Riverside	4,883,898	23. Butte	669,830
9. Yuba	4,852,266	24. Sierra	620,361
10. Santa Cruz	4,080,885	25. Tuolumne	554,483
11. Solano	3,030,198	26. Tulare	552,234
12. Nevada	2,641,081	27. San Diego	501,393
13. Sacramento	2,394,894	28. San Joaquin	474,378
14. Amador	2,368,464	29. Madera	467,667
15. Plumas	1,798,461	30. Trinity	456,882

County	Value	County	Value
31. Placer	$449,070	46. Lassen	$83,485
32. Mariposa	342,601	47. Colusa	80,438
33. Marin	318,776	48. Mono	56,876
34. San Mateo	257,092	49. Mendocino	44,722
35. Stanislaus	236,207	50. San Francisco	41,562
36. Napa	195,239	51. Modoc	36,650
37. Imperial	182,818	52. Merced	33,550
38. Sonoma	175,551	53. Tehama	30,820
39. Lake	174,389	54. Yolo	14,829
40. Monterey	170,155	55. Del Norte	6,029
41. Humboldt	138,597	56. Kings	5,722
42. San Luis Obispo	129,791	57. Alpine	925
43. El Dorado	112,756	58. Sutter	54
44. Glenn	103,197		
45. Siskiyou	93,347	Total	$268,157,472

ALAMEDA.

Area: 843 square miles.
Population: 344,177 (1920 census).

Alameda County, while in no sense one of the 'mining counties,' comes twentieth on the list with a value of mineral products for 1921 of $1,353,690, a decrease from the 1920 total, which was $1,947,880. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$373,258
Pyrites	13,449 tons	70,669
Salt	108,925 tons	370,296
Stone, miscellaneous		513,641
Other minerals*		25,826
Total value		$1,353,690

*Includes magnesium salts, manganese ore, mineral paint, potash.

ALPINE.

Area: 776 square miles.
Population: 243 (1920 census).

Alpine has in the past shown a small production of gold and silver, but dropped out of the list of producing counties in 1914–1918. For 1921, a total value of $925 was reported, as follows:

Substance	Value
Stone, miscellaneous	$925

This county lies just south of Lake Tahoe, in the high Sierra Nevada range of mountains. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work of any kind.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz. silver. tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.
Population: 7,793 (1920 census).

The value of Amador County's mineral production increased from $2,010,200 in 1920, to $2,368,464, placing it number fourteen on the list of counties in the state as regards total value of mineral substances marketed. The advance was due to an increase in gold output.

Although having an output consisting of 7 different minerals, the leading product, gold, makes up approximately 92% of the entire total.

Amador at one time led the state in gold production, but was exceeded in 1920–1921 by Yuba and Nevada counties.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, lime, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay (pottery)	22,124 tons	$46,664
Gold		2,167,443
Silica	1,802 tons	20,646
Silver		35,460
Stone, miscellaneous		1,125
Other minerals*		97,126
Total value		$2,368,464

*Includes brick and platinum.

BUTTE.

Area: 1,722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.

Butte, twenty-third county in California in regard to the value of its mineral output, reported a commercial production of seven mineral substances, having a total value of $669,830 as compared with $641,562 in 1920. As will be noted in the following tabulation, gold is by far the most important item. Butte stands seventh among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver, and miscellaneous stone.

Commercial value for 1921 was as follows:

Substance	Amount	Value
Gems		$331
Gold		456,760
Mineral water	2,900 gals.	4,100
Platinum	31 fine oz.	2,432
Silver		1,759
Stone, miscellaneous		203,900
Other minerals		548
Total value		$669,830

CALAVERAS.

Area: 1,027 square miles.
Population: 6,183 (1920 census).
Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of 7 different minerals, valued at $1,525,201 during the year 1921, as compared with the 1920 output at $1,880,050. Gold, copper, and silver are the chief mineral substances. In regard to total value of mineral output Calaveras stands seventeenth among the counties of the state, and fifth in gold. The decrease, as compared with 1920, is due to copper.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1921 was as follows:

Substance	Amount	Value
Gold		$1,495,758
Mineral water	2,809 gals.	791
Platinum	12 fine oz.	876
Silver		10,232
Stone, miscellaneous		17,527
Other minerals*		17
Total value		$1,525,201

*Includes copper and lead.

COLUSA.

Area: 1,140 square miles.
Population: 9,920 (1920 census).
Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1921 production was $80,438, an increase over the 1920 figures of $57,488, giving it forty-seventh place, and was distributed as follows:

Substance	Value
Stone, miscellaneous	$80,000
Other minerals	438
Total value	$80,438

CONTRA COSTA.

Area: 714 square miles.
Population: 53,889 (1920 census).

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral-producing counties of the state. It stands sixteenth on the list in this respect, however, with an output valued at $1,622,732 for the calendar year 1921. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$198,248
Mineral water	600,300 gals.	6,099
Stone, miscellaneous		415,127
Other minerals		1,003,258
Total value		$1,622,732

DEL NORTE.

Area: 1,024 square miles.
Population: 2,759 (1920 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.

Del Norte rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a wide field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone. The 1921 output was a decrease from the figure of $11,781 in 1920.

Commercial production for 1921, giving it fifty-fifth place, was as follows:

Substance	Value
Stone, miscellaneous	$5,580
Other minerals*	449
Total value	$6,029

*Includes gold, platinum, silver.

EL DORADO.

Area: 1,753 square miles.
Population: 6,426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes forty-third on the list of counties ranked according to the value of their total mineral production during the year 1921. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The decrease from the 1920 figure of $186,432 was due mainly to limestone.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, glass-sand, slate, soapstone, silver, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Gold		$34,109
Limestone	15,296 tons	66,143
Silver		301
Stone, miscellaneous		2,750
Talc	1,652 tons	9,453
Total value		$112,756

FRESNO.

Area: 5,950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.

Fresno County, fourth in importance as a mineral producer among the counties of California, reported an output for 1921 of ten mineral substances, with a total value of $19,498,503, a decrease from the reported 1920 production, which was worth $23,819,351. The bulk of the above is derived from the petroleum production of the Coalinga field.

The mineral resources of this county are many, and, aside from crude oil, are in the main not yet fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$125,276
Gold		13,085
Granite		28,610
Magnesite	945 tons	9,540
Natural gas	1,886,081 M. cu. ft.	190,181
Petroleum	12,161,565 bbls.	18,643,679
Silver		75
Stone, miscellaneous		486,057
Other minerals		2,000
Total value		$19,498,503

GLENN.

Area: 1,259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.

Glenn County, standing forty-fourth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1921 was as follows:

Substance	Value
Stone, miscellaneous	$103,197

HUMBOLDT.

Area: 3,634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Nine mineral substances, as shown by the table given below, having a total value of $138,597, were produced in 1921, as compared with the 1920 output, worth $159,796, the decrease being due to manganese. Humboldt ranks forty-first among the counties of the state for the year.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay (pottery)	75 tons	$190
Gold		2,054
Silver		37
Stone, miscellaneous		131,688
Other minerals*		4,628
Total value		$138,597

*Includes brick, mineral water, natural gas, platinum, pumice.

IMPERIAL.

Area: 4,089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.

During 1921 Imperial County produced five mineral substances having a total value of $182,818, as compared with the 1920 output, worth $169,882. Its rank is thirty-seventh. This county contains deposits of gold, gypsum, lead, marble, pumice, salt, silver, and strontium, largely undeveloped.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Brick	654 M.	$6,363
Gold		537
Silver		920
Stone, miscellaneous		171,173
Other minerals		3,825
Total value		$182,818

INYO.

Area: 10,019 square miles.
Population: 7,031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1921 reached a value of $1,460,218, standing eighteenth among the counties of the state in this respect. The 1920 value was $3,889,400, the decrease being due mainly to borax, lead, soda, and silver. Its mineral resources include antimony, asbestos, barytes, borax, copper, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Copper	45,725 lbs.	$5,898
Dolomite	22,112 tons	49,073
Fuller's earth	1,185 tons	8,295
Gold		80,373
Lead	1,052,253 lbs.	47,351
Silver		86,020
Stone, miscellaneous		16,250
Talc	4,350 tons	77,250
Other minerals*		1,089,708
Total value		$1,460,218

*Includes borax, building stone, marble, pumice, soda.

KERN.

Area: 8,003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.

Kern County, because of its immensely productive oil fields, stands preeminent among all counties of California in the value of its mineral output, the exact figures for 1921 being $100,840,933. This is larger by more than fifty million dollars than the succeeding county on the list. This figure also is nearly six and one-half times the value of the total gold output of the entire state for 1921. The 1920 mineral output for Kern County was worth $89,121,581. The increase was due to larger production and the enhanced prices for crude oil of all grades.

Among the mineral resources, developed and undeveloped, of this section are: Antimony, asphalt, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Brick	5,840 M	$85,820
Gold		84,698
Lime	72,629 bbls.	141,491
Natural gas	40,136,930 M. cu. ft.	1,926,797
Petroleum	57,434,945 bbls.	97,639,407
Salt	18,500 tons	93,500
Silver		1,897
Stone, miscellaneous		38,208
Other minerals*		829,115
Total value		$100,840,933

*Includes cement, gypsum, limestone, silica.

KINGS.

Area: 1,159 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way, but there has, as yet, been no commercial output recorded. The decrease in 1921 was due mainly to quicksilver.

Tulare Lake is in Kings County.

In fifty-sixth place, commercial mineral production in this county for 1921 was as follows:

Substance	Amount	Value
Natural gas	2,090 M. cu. ft.	$980
Other minerals		4,742
Total value		$5,722

LAKE.

Area: 1,278 square miles.
Population: 5,542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver, and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

The increase in value from $63,553 in 1920, to $174,389 in 1921, was due to large amounts of crushed rock, sand and gravel used on highway work and in dam construction for hydroelectric power development.

In thirty-ninth place, commercial production for 1921 was as follows:

Substance	Amount	Value
Mineral water	54,715 gals.	$26,751
Quicksilver	22 flasks	880
Stone, miscellaneous		146,508
Other minerals		250
Total value		$174,389

LASSEN.

Area: 4,531 square miles.
Population: 8,507 (1920 census).
Location: Northeast portion of state.

Lassen County is one of the little explored sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important.

In forty-sixth place, commercial production for 1921 was as follows:

Substance	Value
Gold	$39,943
Silver	1,234
Stone, miscellaneous	42,308
Total value	$83,485

LOS ANGELES.

Area: 4,067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1921 amounted in value to $31,704,941 as compared with the 1920 output, worth $26,975,163. This county ranked third in the state as a mineral producer in 1920 and 1921, having passed Fresno in 1919 which was previously fourth. The advance was due mainly to the large increase in the petroleum valuation, and in part to an increase in the output of bricks and building tile.

Its output of brick and tile was over three milion dollars, and that of petroleum amounted to over twenty-five million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1921, consisting of 14 substances, was as follows:

Substance	Amount	Value
Brick and tile		$3,208,448
Clay (pottery)	29,055 tons	62,866
Mineral water	264,468 gals.	13,314
Natural gas	6,944,277 M. cu. ft.	638,936
Petroleum	12,395,605 bbls.	25,795,254
Stone, miscellaneous		1,763,180
Other minerals*		222,943
Total value		$31,704,941

*Includes borax, gems, gold, graphite, limestone, magnesium chloride, salt, silver.

MADERA.

Area: 2,112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.

Madera County produced four mineral substances during the year 1921, having a total value of $467,667, as compared with the 1920 output worth $122,925. The increase is due mainly to granite. This county contains deposits of copper, gold, iron, lead, molybdenum, pumice, silver, and building stone.

In twenty-ninth place, commercial production for 1921 was as follows:

Substance	Value
Gold	$1,053
Granite	461,822
Silver	27
Stone, miscellaneous	4,765
Total value	$467,667

MARIN.

Area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.

Mineral production in Marin County during the year 1921 reached a value of $318,776, as compared to the 1920 output, worth $335,745, the decrease being due to crushed rock, and brick. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirty-third place, commercial production for 1921 was:

Substance	Value
Stone, miscellaneous	$202,333
Other minerals*	116,443
Total value	$318,776

*Includes brick and mineral water.

MARIPOSA.

Area: 1,463 square miles.
Population: 2,775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but thirty-second on the list of counties in regard to the value of its mineral output for 1921, with a total of $342,601 as compared with the 1920 figure of $271,031, the increase being due to gold.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production in 1921 was as follows:

Substance	Value
Gold	$331,295
Silver	5,251
Stone, miscellaneous	400
Other minerals*	5,655
Total value	$342,601

*Includes barytes and pyrites.

MENDOCINO.

Area: 3,453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1921 output being valued at $44,722, ranking it forty-ninth among the counties. That of 1920 was worth $26,110.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold and silver.

Commercial production for 1921 was as follows:

Substance	Value
Gold	$1,509
Silver	13
Stone, miscellaneous	40,000
Other minerals*	3,200
Total value	$44,722

*Includes brick, manganese ore, natural gas, platinum.

MERCED.

Area: 1,995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley, and it figures as one of the lesser mineral producing counties of the state. The 1921 mineral output was valued at $33,550. Gold, platinum, and silver were formerly obtained by dredging, which ceased in this county in 1918, though a small yield from other sources was reported in 1921. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In fifty-second place, commercial production during 1921 was as follows:

Substance	Value
Gold	$3,163
Silver	87
Stone, miscellaneous	30,300
Total value	$33,550

MODOC.

Area: 3,823 square miles.
Population: 5,425 (1920 census).
Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are: Clay, coal, gold, iron, quicksilver, salt, and silver. In fifty-first place, commercial production for 1921 was as follows:

Substance	Value
Stone, miscellaneous	$34,930
Other minerals*	1,720
Total value	$36,650

*Includes gem material and salt.

MONO.

Area: 3,030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the State of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a rather inaccessible country and has been but superficially explored. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-eighth place, commercial production for 1921 was as follows:

Substance	Amount	Value
Copper	2,940 lbs	$379
Gold		37,754
Lead	42,962 lbs.	1,933
Silver		15,160
Other minerals*		1,650
Total value		$56,876

*Includes onyx and salt.

MONTEREY.

Area: 3,330 square miles.
Population: 27,980 (1920 census).
Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced eight mineral substances during the year 1921, having a total value of $170,155, as compared with the 1920 output worth $126,449, the increase being due to coal. Its mineral resources include brick, clay, copper, coal, dolomite, feldspar, fuller's earth, gold, silver, gypsum, infusorial earth, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In fortieth place, commercial production for 1921 was as follows:

Substance	Amount	Value
Dolomite	2,500 tons	$8,750
Stone, miscellaneous†		63,316
Other minerals*		98,089
Total value		$170,155

†Includes molding, building, blast, filter, and roofing sand.
*Includes absestos, coal, diatomaceous earth, mineral water, salt, glass-sand.

NAPA.

Area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties'.

Napa, because of its production of structural and industrial materials and mineral water, stands thirty-sixth on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1921, the value of the output decreased to $195,239 from the 1920 figure of $230,141, due mainly to quicksilver.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Mineral water	72,364 gals.	$55,760
Quicksilver	35 flasks	1,659
Stone, miscellaneous		111,100
Other minerals		26,720
Total value		$195,239

NEVADA.

Area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921. Nevada County stands twelfth on the list in regard to value of its total mineral output, with a figure of $2,641,081, as compared with the 1920 production worth $2,955,006. The decrease is due mainly to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

Commercial production for 1921 was as follows:

Substance	Value
Gold	$2,570,162
Silver	33,906
Stone, miscellaneous	19,151
Other minerals*	17,862
Total value	$2,641,081

*Includes asbestos, barytes, granite.

ORANGE.

Area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral-producing section. It stands, however, as the second county in the state in regard to the total value of mineral output for 1921, its highly productive oil fields making such a condition possible.

This county, in company with most of the other oil counties, shows a gain in 1921, with a total value of mineral products of $47,499,030, compared to the 1920 output, worth $34,108,136. It passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Brick	2,994 M.	$47,720
Natural gas	14,097,639 M. cu. ft.	1,312,704
Petroleum	22,929,466 bbls.	45,996,509
Stone, miscellaneous		131,301
Other minerals*		10,796
Total value		$47,499,030

*Includes clay (pottery), copper, gold, lead, silver.

PLACER.

Area: 1,395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.

While standing only thirty-first on the list of mineral-producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are: Asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1921 was as follows, compared to a total value of $612,813 for the preceding year:

Substance	Amount	Value
Brick and tile		$144,508
Clay (pottery)	76,665 tons	95,930
Gold		132,468
Granite		48,328
Silver		1,068
Stone, miscellaneous		21,490
Other minerals*		5,278
Total value		$449,070

*Includes chromite, mineral paint, silica.

PLUMAS.

Area: 2,594 square miles.
Population: 5,681 (1920 census).
Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Lack of transportation and other facilities has retarded its growth, but its future is promising. Mineral production for 1921 was valued at $1,798,461, as compared with the 1920 output, worth $2,082,662, the decrease being due mainly to copper. This placed the county fifteenth in rank. In 1919–1921 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down.

Among its mineral resources are: Chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Copper	11,584,216 lbs.	$1,494,364
Gold	--------------	127,148
Lead	2,961 lbs.	133
Platinum	18 fine oz.	1,615
Silver	--------------	171,090
Other minerals*	--------------	4,111
Total value		$1,798,461

*Includes granite and miscellaneous stone.

RIVERSIDE.

Area: 7,240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.

Riverside is the fourth county in the state in size and the eighth in regard to the total value of mineral output for 1921. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials, and salines, some of the more important being brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, glass-sand, soapstone, silver, miscellaneous stone, and tin. In point of variety Riverside County showed eleven different minerals commercially produced in 1921.

The decrease in 1921 from the 1920 value of $5,128,208 is due mainly to clay products.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Brick and tile	--------------	$376,553
Clay (pottery)	84,224 tons	111,219
Feldspar	2,094 tons	14,808
Granite	--------------	12,852
Mineral water	56,400 gals.	2,945
Silica	1,625 tons	6,357
Stone, miscellaneous	--------------	431,671
Other minerals*	--------------	3,927,493
Total value		$4,883,898

*Includes cement, coal, gems, potash.

SACRAMENTO.

Area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.

Sacramento stands thirteenth among the counties of the state as a mineral producer, the output, principally gold, for 1921 being valued at $2,394,894, as compared with the 1920 production, worth $2,066,154. In regard to gold output alone this county ranks fourth, being exceeded only by Yuba, Amador, and Nevada counties, the product coming from the dredges. Its mineral resources include: Brick, clay, gold, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Value
Brick and tile	$216,402
Gold	1,690,662
Granite	39,469
Silver	5,254
Stone, miscellaneous	386,911
Other minerals*	56,196
Total value	$2,394,894

*Includes natural gas and platinum.

SAN BENITO.

Area: 1,392 square miles.
Population: 8,995 (1920 census).
Location: West-central portion of state.

Although nineteenth among the counties of the state in regard to value of total mineral production, San Benito led for some years in one important branch of the mineral industry, namely, quicksilver. In spite of the shut-down of the quicksilver mines in 1921, San Benito County retained its position on account of cement, which showed an increased yield over the 1920 figures.

Its other mineral resources, many of them undeveloped, include: Antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Value
Stone, miscellaneous	$269,334
Other minerals*	1,116,759
Total value	$1,386,093

*Includes asbestos, cement, dolomite, magnesite, mineral water, quicksilver.

SAN BERNARDINO.

Area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state, in area, ranks sixth as regards the value of its mineral output for 1921 with a total of $9,375,540, as compared with the 1920 total of $6,541,348. The increase is due to cement and silver.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1921 a total of 23 different substances.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, glass-sand, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Borax	3,718 tons	$338,905
Calcium chloride	683 tons	22,980
Cement	1,964,926 bbls.	4,633,437
Copper	17,054 lbs.	2,200
Gold		217,568
Lead	22,812 lbs.	1,027
Limestone	21,862 tons	106,195
Potash	7,202 tons	211,067
Salt	13,279 tons	67,782
Silver		3,210,706
Stone, miscellaneous		145,572
Talc	2,750 tons	43,375
Other minerals*		374,726
Total value		$9,375,540

*Includes clay (pottery), dolomite, feldspar, gems, granite, gypsum, iron ore, lime, mineral water, pumice, soda.

SAN DIEGO.

Area: 4,221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.

San Diego ranks twenty-seventh in the total value of its mineral output. This figure for 1921 equaled $501,393, as compared with the 1920 output worth $794,229. In 1918, for the only time in several years, there was no production of gems, in which San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

A development of recent years is the shipping of pebbles for grinding mills.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$92,600
Feldspar	1,850 tons	11,100
Gems		1,405
Granite		22,444
Mineral water	70,924 gals.	9,161
Sand (glass)	370 tons	725
Stone, miscellaneous		187,922
Other minerals*		176,036
Total value		$501,393

*Includes gold, lithia, magnesium salts, marble, salt, silver.

SAN FRANCISCO.

Area: 43 square miles.
Population: 506,676 (1920 census).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In fiftieth place, commercial production for 1921 was as follows:

Substance	Value
Stone, miscellaneous	$41,562

SAN JOAQUIN.

Area: 1,448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1921 having a total value of $474,378, as compared with the 1920 output, worth $471,102.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-eighth place, commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$318,242
Manganese ore	425 tons	3,750
Natural gas	204,057 M. cu. ft.	79,571
Stone, miscellaneous		72,815
Total value		$474,378

SAN LUIS OBISPO.

Area: 3,334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1921 was $129,791, as compared with the 1920 output, worth $405,604, the decrease being due mainly to quicksilver and soda. Among its mineral resources, both developed and undeveloped, are: Asphalt, bituminous rock, brick, chromite, coal, copper, gypsum, infusorial earth, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda, and miscellaneous stone.

In thirty-first place, commercial production for 1921 was as follows:

Substance	Amount	Value
Petroleum	30,725 bbls.	$43,691
Stone, miscellaneous		80,000
Other minerals*		6,100
Total value		$129,791

*Includes chromite, diatomaceous earth, mineral water.

SAN MATEO.

Area: 447 square miles.
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1921 equaled $257,092, as compared with the 1920 figures of $293,103, the decrease being due to salt.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below.

Bricks have also been produced commercially.

In thirty-fourth place, commercial production for 1921 was as follows:

Substance	Amount	Value
Petroleum	322 bbls.	$966
Salt	32,587 tons	167,022
Stone, miscellaneous		61,697
Other minerals*		27,407
Total value		$257,092

*Includes brick, magnesium chloride, potash.

SANTA BARBARA.

Area: 2,740 square miles.
Population: 41,097 (1920 census).
Location: South-western portion of state, joining San Luis Obispo on the south.

Santa Barbara County owes its position of fifth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1921 was $10,190,929, as compared with the 1920 output of $10,538,611.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Mineral water	97,847 gals.	$133,590
Natural gas	1,544,892 M. cu. ft.	145,179
Petroleum	5,465,942 bbls.	9,122,657
Potash	143 tons	5,720
Stone, miscellaneous		65,600
Other minerals*		718,183
Total value		$10,190,929

*Includes bituminous rock, diatomaceous earth, sandstone.

SANTA CLARA.

Area: 1,328 square miles.
Population: 100,588 (1920 census).
Location: West-central portion of state.

Santa Clara County reported a mineral output for 1921 of $750,708, as compared with the 1920 figures of $1,038,692, the decrease being due to potash and quicksilver.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone. It led in quicksilver yield for the year.

In twenty-second place, commercial production for 1921 was as follows:

Substance	Amount	Value
Brick	7,501 M.	$110,961
Clay (pottery)	1,126 tons	2,300
Magnesite	25,800 tons	280,000
Mineral water	2,500 gals.	275
Petroleum	13,964 bbls.	26,943
Stone, miscellaneous		138,584
Other minerals*		191,645
Total value		$750,708

*Includes limestone marl, potash, quicksilver.

SANTA CRUZ.

Area: 435 square miles.
Population: 26,269 (1920 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $4,080,885, giving the county a standing of tenth among all others in the state in this regard.

The increase over the 1920 figure of $3,081,138, is due mainly to cement.

The commercial production for 1921 was as follows:

Substance	Amount	Value
Lime	122,907 bbls.	$242,869
Stone, miscellaneous		22,895
Other minerals*		3,815,121
Total value		$4,080,885

*Includes bituminous rock, cement, limestone, mineral paint, potash.

SHASTA.

Area: 3,858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.

Shasta County stood twenty-first in California among the mineral producing counties for 1921, with an output valued at $841,062, as compared with the 1920 production worth $1,108,538. The marked decrease in 1918–1921 was due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin; but in 1919–1921 was passed by San Bernardino, Inyo, Yuba, Plumas, Amador, Calaveras, Nevada, and Sacramento, among the 'metal' counties.

Shasta's mineral resources include: Asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Copper	437,593 lbs.	$56,449
Gold		267,681
Platinum	219 fine oz.	26,817
Silver		5,581
Stone, miscellaneous		31,945
Other minerals*		452,589
Total value		$841,062

*Includes asbestos, barytes, iron ore, lead, pyrites, zinc.

SIERRA.

Area: 923 square miles.
Population: 1,783 (1920 census).
Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $620,361, consisting mainly of gold and silver, during the year 1921, as compared with the 1920 output, worth $446,861. Considering gold output alone, this county stands sixth; and as to total mineral yield twenty-fourth.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, minerals, serpentine, and talc.

Commercial production for 1921 was as follows:

Substance	Value
Gold	$612,267
Silver	5,236
Stone, miscellaneous	2,858
Total value	$620,361

SISKIYOU.

Area: 6,256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks forty-fifth in regard to the value of its mineral output for 1921. The decrease in 1921 was due mainly to gold, copper, and mineral water.

Although the county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable degree.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are: Chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Gold		$42,635
Mineral water	250,150 gals.	5,015
Silver		294
Stone, miscellaneous		44,343
Other minerals*		1,060
Total value		$93,347

*Includes asbestos, chromite, brick, lime, platinum.

SOLANO.

Area: 822 square miles.
Population: 40,602 (1920 census).
Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1921 to the total value of $3,030,198, ranking eleventh among the counties of the state, the increase over the 1920 figures of $2,930,614 being due to cement. Among her mineral resources are: Brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Value
Stone, miscellaneous	$60,604
Other minerals*	2,969,594
Total value	$3,030,198

*Includes cement, mineral water, onyx.

SONOMA.

Area: 1,577 square miles.
Population: 51,990 (1920 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked thirty-eighth among the counties of California during the year 1921, with a mineral production of $175,551, as compared with its 1920 output worth $287,245. More paving blocks have been turned out here than in any other section of the state, but this industry has now practically ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are: Brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Mineral water	37,641 gals.	$9,891
Stone, miscellaneous		151,300
Other minerals*		14,360
Total value		$175,551

*Includes gems, magnesite, quicksilver.

STANISLAUS.

Area: 1,450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921 by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1921 ranks thirty-fifth in the state in regard to value of minerals, with an output of $236,207, as compared with $385,017 in 1920, the decrease being due mainly to gold. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Gold		$18,439
Magnesite	3,378 tons	33,158
Silver		136
Stone, miscellaneous		180,697
Other minerals*		3,777
Total value		$236,207

*Includes manganese ore, mineral paint, platinum, quicksilver.

SUTTER.

Area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, but there was no production in 1918, nor 1919. There has been some utilization of natural gas. The 1921 mineral yield was valued at $54, being concealed under 'unapportioned.' Both coal and clay exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA.

Area: 2,893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fiftieth among the mineral producing counties of the state for 1921, when its output was valued at $30,820, as compared with the 1920 yield worth $26,400.

Among its mineral resources are listed: Brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1921 yield was distributed as follows:

Substance	Value
Stone, miscellaneous	$30,520
Other minerals	300
Total value	$30,820

TRINITY.

Area: 3,166 square miles.
Population: 2,551 (1920 census).
Location: Northwestern portion of state.

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver, and platinum, very little active production of these mineral substances has been made as yet. The 1921 output of $456,882 shows a decrease from the 1920 figure of $562,105.

In thirtieth place, commercial output for 1921 was:

Substance	Amount	Value
Gold		$437,993
Platinum	27 fine oz.	3,260
Silver		1,390
Other minerals*		14,239
Total value		$456,882

*Includes quicksilver and miscellaneous stone.

TULARE.

Area: 4,856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands twenty-sixth on the list of mineral-producing counties, the decrease from the 1920 value being due mainly to magnesite. This county's mineral resources, among others, are: Brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years has led the state in magnesite output, except in 1918 when it was passed by Napa County, and in 1921 by Santa Clara.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Limestone	10,030 tons	$40,090
Magnesite	11,454 tons	125,594
Natural gas	380 M. cu. ft.	190
Stone, miscellaneous		284,122
Other minerals*		102,238
Total value		$552,234

*Includes brick and granite.

TUOLUMNE.

Area: 2,190 square miles.
Population: 7,768 (1920 census).
Location: East-central portion of state—Mother Lode District.

Tuolumne ranks twenty-fifth among counties of the state relative to its total value of mineral output for 1921. This county ranks first as a producer of marble in the state. The increase in the year's valuation to $554,483 for 1921, over the 1920 figure of $513,914 was due to the large amounts of crushed rock, sand and gravel being used on the Hetch Hetchy project of the City of San Francisco, although there was a considerable decrease in the county's gold yield.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1921 was as follows:

Substance	Amount	Value
Gold		$96,026
Limestone	3,650 tons	9,475
Silver		2,505
Stone, miscellaneous		229,185
Other minerals*		217,292
Total value		$554,483

*Includes dolomite, granite, lime, marble.

VENTURA.

Area: 1,878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the seventh county in the state in respect to the value of its mineral production for 1921, the exact figure being $6,245,269, as compared with the output for 1920, worth $5,229,175, the advance being due to petroleum.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are: Asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

The commercial production for 1921 was as follows:

Substance	Amount	Value
Clay and clay products		$3,985
Natural gas	2,127,476 M. cu. ft.	360,443
Petroleum	2,167,326 bbls.	5,869,119
Stone, miscellaneous		11,250
Other minerals*		472
Total value		$6,245,269

*Includes mineral paint and sandstone.

YOLO.

Area: 1,014 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1921 consisted mainly of miscellaneous stone, valued at $14,829, ranking it in fifty-fourth place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA.

Area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas.

Yuba is ninth of the mineral producing counties of the state, and leads in regard to gold output, surpassing both Nevada and Amador counties in 1918-1921 in that metal. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1921. The increase over the 1920 figure of $3,573,649 was due to gold obtained by the dredgers, which also yield silver and platinum.

The 1921 production of Yuba County was distributed as follows:

Substance	Amount	Value
Gold		$4,738,248
Platinum	179 fine oz.	14,396
Silver		26,135
Stone, miscellaneous		73,387
Other minerals		100
Total value		$4,852,266

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as by those who utilize the facilities of the collection.

During the month a total of 450 visitors signed their names to the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

LABORATORY.

FRANK SANBORN, Petrologist.

A total of 264 samples were received and determined during the thirty-day period covered by this report. There were few among the number of special scientific interest.

In a previous issue of this report the occurrence of a lime phosphate from Tulare County was mentioned. An analysis of the sample gave 36.80 per cent phosphoric anhydride (P_2O_5). A large deposit of this material would be valuable.

A list of samples of possible commercial value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–283	Zinc-copper ore; some silver present.
05–284	Barite, fair quality.
05–285	Oxides of iron, possibly make paint pigment.
05–286	Massive garnet.
05–287	Arsenopyrite with quartz.
05–288	Barite; good grade.
05–289	Lead vanadate.
05–290	Copper ore; low grade.
05–291	Spinel.
05–292	Galena; some silver present.
05–293	Black sand; contains gold and platinum.
05–294	Quartz; good grade.
05–295	Limonite (yellow ocher).
05–296	Copper ore; contains a little gold.
05–297	Copper ore, some gold and silver present; also barite.
05–298	Asbestos (chrysotile), good grade.
05–299	Clay, burns white.
05–300	Sulphur.
05–301	Sand; contains platinum and gold.
05–302	Wollastonite; also limestone.
05–303	Gold-silver ore.
05_304	Complex material; contains scorodite (ferric arsenate).
05–305	Copper ore, some gold and silver present.
05–306	Asbestos (short fiber chrysotile).
05–307	Quartz and galena; also wulfenite.
05–308	Sodium sulphate with some sodium chlorite; also gypsum.
05–309	Massive garnet.
05–310	Quartz and iron oxide; contains gold.
05–311	Gold ore; contains some copper and lead.
05–312	Fluorite; also limestone.

LIBRARY.

E. Cooney, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

- U. S. Geol. Survey:
  - Bulletin No. 722—Mineral Resources of Alaska. By A. H. Brooks and others.
  - Bulletin No. 724—Nitrate Deposits in the Amargosa Region, Southeastern California. By L. F. Noble, G. R. Mansfield and others.
  - Water Supply Paper No. 450-C—Ground Water in Pahrump, Mesquite and Ivanpah Valleys, Nevada and California. By Gerald A. Waring.
  - Water Supply Paper No. 463—Surface Water of the United States, 1917. By Nathan C. Grover, G. C. Baldwin, G. L. Parker and F. F. Henshaw.
  - Salt, Bromine and Calcium Chloride in 1921.
  - Clay in 1921.
  - Mineral Resources of the United States in 1921 (Preliminary Summary).
  - Professional Paper No. 131-B. A Section of the Paleozoic Formations of the Grand Canyon at the Bass Trail. By L. F. Noble.
- U. S. Bureau of Mines:
  - Technical Paper 188—Corrosion Under Oil Films, With Special Reference to the Cause and Prevention of the After Corrosion of Firearms, by Wilbert J. Huff.
  - Technical Paper 290—Inclusions in Aluminum-Alloy Sand Castings. By R. J. Anderson.
  - Technical Paper 292—Tests of Gas Masks and Respirators for Protection from Locomotive Smoke in Railroad Tunnels, with Analyses of Tunnel Atmospheres. By A. C. Fieldner, S. H. Katz and S. P. Kinney.
  - Technical Paper 309—Recent Progress in the Thawing of Frozen Gravel in Placer Mining. By Charles Janin.
  - Bulletin No. 199—Experimental Production of Alloy Steels. By H. W. Gillett and E. L. Mack.

Reports of Investigations:

Serial No. 2380—Use of Geophone in Locating Compressed-air Leaks. By Byron O. Pickard (M. E.—U. S. B. M.)

Serial No. 2381—The Rate of Reduction of Hematite to Magnetite by Bethane. By C. M. Bouton (Physical Chemist, U. S. B. M.).

Serial No. 2382—The White Clay Industry in the Vicinity of Langley, South Carolina. By W. M. Weigel (Mineral Technologist, U. S. B. M.).

Serial No. 2383—Ignition of Gas by Electric Detonators. By L. C. Ilsley (Electrical Engineer) and A. B. Hooker (Asst. Electrical Engineer, B. M.).

Serial No. 2384—Failure of Center Shots in Blasting. By L. C. Ilsley (Electrical Engineer, B. M.) and A. B. Hooker (Asst. Electrical Engineer, B. M.).

Serial No. 2385—Tellurium. By H. A. Doerner (Chemist, B. M.).

Serial No. 2386—Comminuted Smokeless Powder as a Blasting Agent. By C. E. Munroe (Chief Explosives Chemist, B M.) and Spencer P. Howell (Explosive Engineer, B. M.).

Serial No. 2387—Explosives Used in June, 1922. By W. W. Adams (Statistician, B. M.).

Serial No. 2388—Sixth Semi-Annual Motor Gasoline Survey. By A. D. Bauer (Assist. Petroleum Chemist, B. M.) and N. F. LeJeune (Asst. Chemist, B. M.).

Serial No. 2389—Fatalities at Coal Mines in July, 1922. By W. W. Adams (Statistican, B. M.).

Serial No. 2390—The New Albany Shale of Indiana. By John R. Reeves (Dept. of Geology, Indiana University).

Serial No. 2391—Underground Hygiene and Sanitation. By R. R. Sayers (Chief Surgeon, U. S. B. M., P. A Surgeon, U. S. P. H. S.).

U. S. Dept. of Commerce:

Supplement to Commerce Reports Nos. 11, 12, 13, 14, 15 and 16.

Bulletin No. 48—Topographic and Geological Survey, Commonwealth of Pennsylvania—Pyrite from Bituminous Coal Mines in Pennsylvania. By Henry Leighton.

Bulletin No. 49—Coal Beds in Clarion County, Pennsylvania. By J. D. Sisler.

Bulletin No. 50—New Oil Pool at Tidioute and Gas Pools Near Corry and Meadville, Pennsylvania. By M. E. Johnson.

Bulletin No. 52—Coal Beds in Mercer, Crawford, Venango Forest, Warren, McKean, Potter, Tioga and Bradford Counties, Pennsylvania. By J. D. Sisler.

Bulletin No. 53—Coal Reserves in Clearfield County, Pennsylvania. By John F. Reese.

Bulletin No. 54—Bituminous Coal Reserves in Pennsylvania. By John F. Reese.

Bulletin No. 56—Oil Fields Rejuvenated. By Robert B. Bossler.

Bulletin No. 25—Geological Survey of Alabama—Statistics of the Mineral Production of Alabama for 1919 and 1920. By J. H. Wingard.

Museum Paper No. 5—Alabama Museum of Natural History.

University of California, Geological Series, Vol. 14, No. 1—Geology and Ore Deposits of the Santa Fe District, Mineral County, Nevada. By Bruce L. Clark.

Vol. 14, No. 2—The Chuquicamata Ore Body. By John A. Hendricks.

Vol. 14, No. 4—A New Family and New Genus from the Tertiary of the Pacific Coast. By Bruce L. Clark.

Vol. 14, No. 3—Faunal and Stratigraphic Relationships of the Empire Formation, Coos Bay, Oregon. By Henry V. Howe.

Circular No. 4—North Carolina Geological Survey. Drainage Assessments; Their Imposition and Their Collection Under the North Carolina Drainage Laws. By Frank Nash.

Thirty-second Annual Report of the Transvaal Chamber of Mines.

Annual Report of the Department of Mines, New South Wales, for 1921.

Thirtieth Annual Report of the Ontario Department of Mines. Pt. III—Gowganda and Other Silver Areas. By A. G. Burrows.

Pt. IV—Natural Gas in 1920. By E. S. Estlin.

Pt. VI—Boston-Skead Gold Area. By A. G. Burrows and P. E. Hopkins.

Bulletin 549—Canada Department of Mines—Report on Structural Materials Along the St. Lawrence River, Between Prescott, Ont., and Lachine, Que. By Joseph Keele and L. Heber Cole.

Societies and Educational Institutions.

Monthly Bulletin of the Canadian Institute of Mining and Metallurgy, September, 1922.
American Institute of Mining and Metallurgical Engineers, September, 1922.
American Philosophical Society Proceedings—Vol. LXI, Nos. 1 and 2. List of the Society, August, 1922.
Colorado Scientific Society Proceedings, Vol. XI—The Manufacture of Lubricating Products from Wyoming and Colorado Crude Oils. By L. C. Welch.
Aspects of Colorado Oil Shale Industry. By Arthur Hoskin.
Vitamines. By Carroll E. Edson, A. M. M. D.
Concrete Pavements. By Lt. Col. H. C. Boyden.
American Institute of Mining and Metallurgical Engineers Transactions, Vol. LXVII, 1922.
Proceedings of the Mining and Metallurgical Society of America.
Philippine Journal of Science; Vol. 20, Nos. 5 and 6.
Economic Geology; Vol. XVII.
The Geographical Review.
The Journal of Geology; Vol. XXX; No. 6.
The Mining Congress Journal, October, 1922.
Monthly Bulletin of the Canadian Institute of Mining and Metallurgy, October, 1922.
Bulletin of the Institution of Mining and Metallurgy, September, 1922.
Boletin de la Real Academia de Ciencias y Artes de Barcelona; Vol. IV, Num. 6.
Memorias de la Real Academia de Ciencias y Artes de Barcelona; Vol. XVII, Num. 13—Evolucion Historica de la Medicina la Ensenanza. Por El Academico Numerario. Prof. Dr. I. Valenti Vivo.
Vol. XVII, Num. 14—Oceanografia Practica. Por El Academico Numerario. Excmo. Sr. D. Jose Ricart Y. Giralt.
Vol. XVIII; Num. 15—Insectos Nuevos O Poco Conocidos. Por El Academico Correspondiente. R. P. Longinos Navas, S. J.

Books.

Study of Minerals and Rocks. By Austin Flint Rogers.
Mining and Engineers Handbook—2 Vols. By Robert Peele.
Geological Notes on Oil Structures. By Edward Allison Hill.

Maps.

U. S. G. S. Topographical Sheets:
  Round Mountain Quadrangle, Fresno County.
  Pozo Farm Quadrangle, Fresno County.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
American Petroleum Institute, New York.
Brick and Clay Record, Chicago.
Chemical Engineering and Mining Review, London, England.
Cement, Mill and Quarry, Chicago, Illinois.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Hercules Mixer, Washington, Delaware.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Oil Bulletin, Los Angeles.
Mining and Engineering Record, Vancouver, B. C.
Oildom, New York.
Oil Weekly, Houston, Texas.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York.

Oil Trade Journal, New York.
Oil Age, Los Angeles.
Oil News, Galesburg, Illinois.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum Age, New York.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Southwest Builder and Contractor, Los Angeles.
Stone, New York.
Salt Lake Mining Review, Salt Lake City, Utah.
Standard Oil Bulletin, San Francisco.
Safety News, Industrial Accident Commission, San Francisco.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport-Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Georgetown Gazette, Georgetown, Cal.
Gateway Gazette, Beaumont, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Humboldt Standard, Eureka, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oroville Daily Register, Oroville, Cal.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Petroleum Reporter, Etna Mills, Cal.
Plumas National Bulletin, Quincy, Cal.
Plumas Independent, Quincy, Cal.
Placer Herald, Auburn, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Stockton Record, Stockton, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–124 Gold placer mine, 140 acres all gravel patented land.
02–125 Feldspar; tonnage.
02–126 Limestone deposit. Four miles to railroad, Tulare County.
02–127 Gold prospect. Four-foot vein assays $30–$50. Mono County.
02–128 Magnesite mine. One hundred tons on dump and large tonnage in sight. Reasonable price.
02–129 Silver property. Group of seventeen claims at Randsburg, close in.
02–130 Chrysotile asbestos, fiber up to one inch, Tulare County.
02–131 Copper-gold-silver prospect, adjoins Greenhorn Mine, Shasta County. Timber. Can be worked by tunnel.
02–132 Gold property. Large fissure vein. Twenty-one claims in Argus Mountains. Good road and water. Thirteen miles from Trona.
02–133 Amphibole asbestos, in Inyo County, six miles from railroad.
02–134 Copper-gold prospect.
02–135 Magnesite.
02–136 Soapstone and green talc.

Mineral Products or Deposits Wanted.

03–116 Ground flint, ground feldspar, and clays.
03–117 Montmorillonite (rock soap); and bentonite.
03–118 Ochre; limestone; gypsum; magnesite.
03–119 Spodumene and amblygonite.
03–120 Colemanite; deposit or tonnage.

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–38 Assistant Geologist. Technical graduate. Has taught crystallography, mineralogy, lithology, and field geology. Age 21; single. Minimum salary wanted, $125 a month. References.

01–39 Assayer or General Foreman of a lead smelter. One and one-half years' experience as helper, and 4 years as assayer and melter. Age 27; single. Salary wanted, $150. References.

01–40 Engineer and estimator of building construction. (Technical or executive work.) Five and one-half years' experience as engineer, estimator, draftsman, and designer. Age 30; married. References.

During the month one registered applicant was placed.

NOVEMBER, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

Lassen County.

A rich strike of gold ore is reported from the *Buckskin mine* in the Hayden Hill district. At a depth of 150 feet, a ledge of free gold ore was struck and samples taken from the vein show high values. This discovery is the most important made in this district in many years. H. P. Anderson, superintendent.

At the *Juniper mine* in the Hayden Hill district, a new shaft has been recently sunk and it is planned to connect this shaft with the old shaft, thus giving two openings on the property. C. L. Joslyn, superintendent.

Shasta County.

COPPER.

Afterthought Mine. The property is located in sections 10, 11, 25, and 5; T. 33 N., R. 2 W., near the town of Ingot, which is twenty-four miles northeast of Redding. The property is owned by the Afterthought Copper Company, George L. Porter, president; C. A. Crowl, secretary; John Tait Milliken, general manager and consulting engineer. Offices, 1321 Pierce Building, St. Louis, Missouri.

Since Report XIV of the State Mineralogist, (pp. 760–761), a new reverberatory furnace and a 300-ton flotation plant were installed in 1918, and operated during 1919. The Harwood process was applied to the complex copper-zinc ores.

Ore deposits: The copper-zinc ore deposits are limited to zones of disturbance in which the country rock is crushed and sheared. The Copper Hill lode consists of two short, nearly vertical ore bodies, approximately 350 feet apart. They lie close to the contact in rhyolite that encloses fragments of slate. The shear zone contains massive irregular lenticular ore bodies. The two vein systems or lodes are known as the Afterthought and Copper Hill lodes, which strike northwest and southeast, and dip 70 degrees to the northeast.

Mine developments: No. 4 tunnel, the main working adit, is driven N. 85° E., 600 feet, then as a drift southeast 500 feet on the Afterthought lode, and northwest 400 feet on the Copper Hill lode. About 350 feet southeast of the vertical shaft from the surface, a winze has been sunk to a depth of 400 feet. Levels have been driven every 100 feet in the winze below the adit. Total amount of underground workings is approximately 10,000 feet.

Approximately 300,000 tons of ore is reported to be developed, carrying 5.5 ozs. silver, .03 ozs. gold, 16 per cent zinc, and 3 per cent copper. The ore is complex copper-zinc ore finely disseminated, composed largely of sphalerite, pyrite, chalcopyrite and galena, with local traces of bornite. The gangue which forms less than 5 per cent of the ore is barite with some quartz and a trace of calcite.

Mill and smelter: The tonnage treated in the 300-ton flotation plant was a minimum of 275 tons and a maximum of 400 tons, producing about 150 tons of collective concentrate. This shows a ratio of concentration of about 2:1. The collective concentrate, when treated preferentially, gives 60 tons of copper concentrate and 90 tons of zinc concentrate. The ore treated by the mill ran 17 per cent zinc, 3.0 per cent copper, 6 ozs. silver, and .03 ozs. gold. The copper concentrate produced ran 7.2 per cent copper, 12.3 per cent zinc, 23.4 per cent iron, 8.2 per cent barite, 10.7 per cent lime, 10.5 per cent alumina, and 10.5 per cent silica. The zinc concentrate produced ran 2.6 per cent copper, 47.1 per cent zinc, 4.2 per cent iron, 3.3 per cent barite, 4.4 per cent lime, 3.8 per cent alumina, and 3.2 per cent silica.

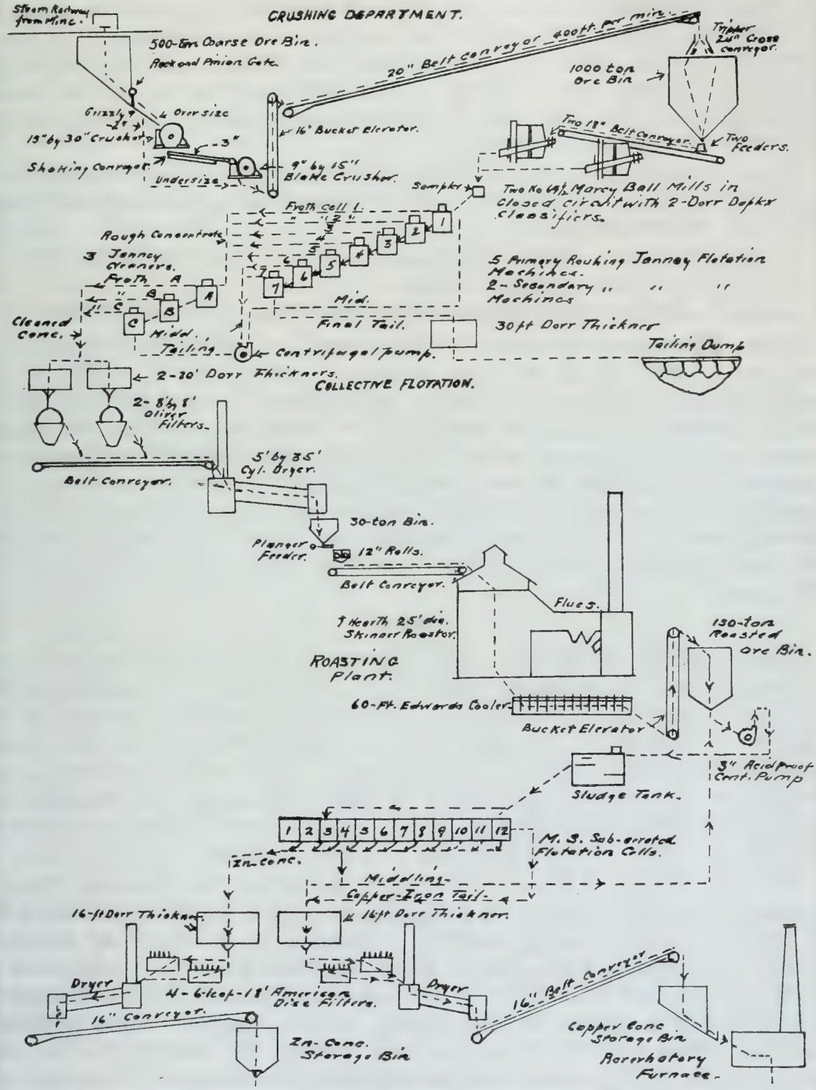
Method of treatment: The ore is crushed to 2-inch ring and ground to pass 48-mesh; it is then subjected to flotation, producing a collective concentrate and a final tailing. The collective concentrate is thickened, filtered, dried and roasted lightly; after cooling, it is subjected to flotation again, this time producing a froth called the zinc concentrate, and a tailing called the copper-iron concentrate. These concentrates are then filtered and dried. (See flow sheet, p. 597.)

Crushing plant: Ore from mine is dumped into 500-ton bin. The ore from bin passes over grizzly with 2-inch openings; the oversize is crushed to 3 inches in 15-inch by 30-inch Blake crusher. The oversize then passes to 9-inch by 15-inch Blake crusher. The discharge from this crusher joins the fine material from 2-inch grizzly and is elevated and conveyed to 1000-ton ore bin at top of mill.

Grinding: The ore from bins is then fed by short conveyors to two No. 64½ Marcy ball mills, each running in closed circuit with a Dorr duplex classifier. Each mill handles 160 tons per 24 hours, and is driven by a 125-h.p. motor. Five-inch forged chrome-steel balls are used and the mills operated at 28 r.p.m.

Collective flotation: The pulp from the classifiers goes direct to 10 sub-aerated Janney machines, ten per unit. Each unit consists of seven roughers and three cleaners. The tailings from cleaners are returned to the head of the mill by means of three-inch sand pumps. The cleaned collective froth goes direct to two 21-foot Dorr thickeners.

The overflow from thickeners is returned to the mill circuit. The thickener discharge runs by gravity to two 8-foot by 8-foot Oliver filters. Filter cake goes to 5-foot by 35-foot cylindrical dryer. The dryer discharges into a 30-ton hopper. The concentrate from the dryer is fed to the top of a 25-foot 9-hearth wedge type Skinner roaster. Roasted concentrates pass through a 60-foot Edwards cooler and are then elevated to a 150-ton bin.



Flow-Sheet of 300-ton Mill
Afterthought Copper Co
Ingot, Shasta County-

Preferential flotation: The discharge from the cooler is conveyed to sludge-tanks, water being added before going to a 12-cell mineral separation sub-aerated flotation machine. Two 16-foot Dorr thickeners are provided for the zinc and copper concentrates. From each of these thickeners, the pulp is drawn to one of four 6-leaf 4-foot American filters; two for copper and two for zinc concentrates. Tailing from the collective department is partly dewatered in 30-foot Dorr thickener. Zinc concentrates pass through the dryer and then go to zinc-concentrate storage bin. Copper concentrates after passing through the dryer are conveyed by a 16-inch belt conveyor to a copper concentrate storage bin, and from this bin to a reverberatory furnace. Recovery on the collective concentrate was 90 per cent of the copper and about 80 per cent of the zinc, while the recovery made by preferential flotation was low, due to lack of agitation and capacity of the minerals separation machine.

The property has been idle since 1919, but eight men are employed on development and maintenance work under the supervision of Robert Milliken, superintendent.

Bibliography: State Mineralogist Report XIV, pp. 670, 671. Bulletin No. 50, pp. 102-105.

A. H. Heller. Mining and Scientific Press, August 2, 1919.

Deep Pit Group of Mines. This group of mines is situated one-half mile south of Heroult, in section 36, T. 34 N., R. 4 W., on the south side of Pit River. Elevation is 900 feet. Owned by T. H. Peterson of Heroult. Holdings consist of 14 claims located along a massive outcrop of iron gossan, which has a general northerly and southerly course. This gossan outcrop can be traced for one mile and is approximately 500 feet wide. Developments consist of a number of tunnels from 20 to 100 feet in length, at different intervals along the outcrop. In these tunnels some pyrite ore has been developed with slight traces of copper.

GOLD.

Janice Group of Mines. This group is situated in Spring Creek mining district, in sections 11 and 12; T. 32 N., R. 6 W., 3 miles northwest of Keswick. Elevation is 1200 feet. Holdings consist of five claims. A series of parallel east and west veins occur in quartz-hornblende-diorite. Dip 65 degrees north. The veins are from 2 to 4 feet wide, the quartz showing free gold with some chalcopyrite and pyrite. Developments consist of two shafts, one 40 feet, the other 50 feet deep. Idle. Frank Sullivan of Shasta, owner.

Peerless Group of Mines. Formerly known as the *Anavina Mine,* is situated 8 miles southwest of Redding, in section 23; T. 31 N., R. 6 W., in the Centerville mining district. Owners: C. S. Jones of Redding, Frank Broadbent and Joseph John of San Francisco. Located in 1885 and worked from 1885 to 1893 by the Anavina Mining Company. There are five claims in the group. Three parallel veins having a general north and south course and dipping 75 degrees to the east, occur in the meta-andesite. The principal development work has been confined to the Peerless vein, which strikes N. 15° W. and dips 75 degrees east. Width, 2 feet. This vein occurs along a fault fissure, cutting the meta-andesite at right angles to the strike of the formation. The vein quartz shows some free gold, with chalcopyrite, pyrite, and galena. At an elevation of 1200 feet, a shaft has been sunk on the vein to a depth of 65 feet, with drifts driven on the 50-foot level north and south. At the elevation of the shaft, a tunnel has been driven 350 feet north on the vein. This vein north of the shaft was extensively worked for pockets and is said to have produced from $6,000 to $10,000. Three men are employed.

PLACER.

Lost Channel Mine. The property lies immediately south of the Clear Creek drainage in the Igo mining district, 12 miles southwest of Redding. Holdings consist of 580 acres, located in sections 34, 3 and 4; T. 31 and 30 N., R. 6 W. Elevation is 1100 feet. Owner, C. A. Russell of Igo; under option to J. W. Newell of Fullerton, California. The 'channel' is in all probability a section of the ancient bed and wash of Clear Creek. The width of this old channel is from one-half to fully one mile across. The present drainage of the Upper Dry Creek, passes directly across the course of the old channel in a southwesternly direction. Deepest depth of the channel is 80 feet.

Character of bedrock: At the northern end of the property, the wash overlies the slates and tuffs. For a distance of about one mile southwesterly, a soft decomposed granite bedrock exists, lying between the slates and sandstones. The sandstone is on the southernly end of the property.

Developments: On the south side of Dry Creek, there is fully 7,000 to 8,000 feet of workings near the Dunham tunnel. Since Report XIV (p. 791), the ground was prospected by a series of drill holes sunk on the north township line, 100 feet apart to a depth of 50 to 65 feet. North of the Dunham tunnel, 12 prospect shafts were sunk, 200 feet apart, east and west across the channel, the depth of these shafts to bedrock being from 18 to 80 feet. Gravel tested ran from 4 to 60 cents per cubic yard, the average value being 12 cents per yard. The ground east and west of Harrison Gulch averaged 50 cents per cubic yard. Three channels have been developed, known as East, West, and Tom White. General course of the channel is north and south. In recent development work, a shaft has been sunk 34 feet deep to bedrock on Los Angeles Gulch. This shaft is one mile north of the Dunham tunnel. To the south of this shaft, two other shafts have been sunk to bedrock. These three shafts are 100 feet apart. Gravel from these three shafts averaged 32 cents per cubic yard. Present work is confined to drifting south on the channel. The gravel mined in the south drift for a height of two feet above bedrock, averaged $10 per cubic yard.

Character of Gold: Very little gold is shown of a size that could be classed as small nuggets except in the main channel, and in the present workings. The distribution in the general wash shows gold running about 10 colors—3 to a cent—on an average. Fineness, 0.873. Total production is reported to be $3,000,000 from 1865 to the present time.

Equipment: Consists of 2 h.p. Fairbanks-Morse gas engine which drives hoist, rod pump and washing machine. Capacity of washer is 30 tons per 24 hours. Three men are employed.

IRON.

The *Noble Electric Steel Company* of San Francisco, who are operating the *Shasta Iron mine* near Heroult, are shipping 160 tons of iron ore per week to steel plants at San Francisco and Los Angeles. E. Y. Dougherty, manager.

Siskiyou County.

The Granite Mine, situated on Humbug Mountain, about 16 miles northwest of Yreka, is to be reopened by the Garrett interests. It is proposed to drive an 800-foot crosscut tunnel below the old workings.

In the Humbug district, it is reported that *John Dowling* and *William Bannister* have discovered an extensive deposit of rich gravel on the slope of Humbug Mountain.

The Oak Bottom Placer Syndicate and *The Victory Gold Mining Company,* two of the largest hydraulic operators in Siskiyou County, both of whom have a number of properties in the Salmon River district, are preparing to operate this winter on a large scale. The Oak Bottom Company has installed a large hydraulic plant and flume line. John Nefroney is manager of the Oak Bottom Company.

The Eliza Mine, Yreka, is being reopened by R. H. DeWitt of Yreka.

Trinity County.

Layman Mine property is situated in section 29; T. 32 N., R. 11 W., in the Hayfork mining district, 4 miles southeast of Hayfork. Elevation is from 3000 feet to 3800 feet. Owners: L. J. Layman, Olonza Layman and Benjamin Murphy of Hayfork. Holdings consist of six unpatented claims, 120 acres. A series of parallel quartz veins occur in the slate and schist. Widths vary from a few inches up to 4 feet. The general trend of the veins is northwestward with dips of about 30 to 45 degrees to the north. The narrow veins, as a rule, are high grade, showing considerable free gold. The shoots of ore are short, about 80 feet being the maximum. The different veins have been developed by a number of tunnels and open cuts. The most recent work has been on the Gold Hill claim. At an elevation of 3400 feet, a crosscut tunnel was driven 45 feet to the vein, which strikes N. 80° W., and dips 50 degrees north. The vein developed in these workings is 12 feet wide. This vein has been drifted on 50 feet, and a winze sunk on the hanging wall to a depth of 20 feet. Ore has been stoped above the tunnel level to the surface, a distance of 25 feet. This ore is reported to have milled $15 per ton. Property was operated during the early part of 1922. Five-stamp mill on the property.

Bibliography: State Mineralogist Report XIV, p. 894.

Hayfork Mine property is situated in section 18; T. 31 N., R. 11 W., in the Hayfork mining district, 3½ miles southeast of Hayfork. Elevation is 3400 feet. Holdings consist of five claims; 100 acres. Vein strikes N. 60° W., and dips 40 degrees south, in schist. Development consists of two crosscut tunnels, the lower one being 500 feet and the upper, 300 feet in length. Two men employed. Owner: Dr. C. A. Mueller, of Redding, California.

Strode Mine. Formerly known as the *Oro Grande,* in sections 8 and 9, T. 37 N., R. 7 W., in the Trinity Center mining district, 2½ miles northeast of Carrville in the Shasta Forest Reserve. Elevation is 2600 feet. Owners: Strode Mining Company, J. S. Maxwell, president; John Phillips, secretary. Offices, 713 Caswell Block, Milwaukee, Wisconsin.

Holdings consist of 11 claims. The vein occurs on a contact between serpentine and porphyry and is from 2½ to 4 feet wide, striking northwest and dipping 40 degrees northeast. The main tunnel, No. 6, driven westward, cut the vein 300 feet from the portal, then drifted on the vein 1000 feet. There is a raise from No. 6 tunnel, 140 feet in ore to No. 5 tunnel. Throughout this raise, the vein averages 4 feet wide. An intermediate drift, 40 feet above No. 6 tunnel, developed a shoot of ore 200 feet long. From No. 5 tunnel, 100 feet above No. 4 tunnel, the ore shoot has been stoped. This ore is reported to have milled $13 per ton. A new tunnel has been driven 1200 feet, 210 feet below No. 6 tunnel, and it is reported No. 1 ore shoot has been opened up on this level for a distance of 300 feet. The vein is 2 to 6 feet wide and is said to carry high values in gold. The compaiy is continuing development work on this level to cut No. 2 ore shoot. On this level the vein has an average width of 3 feet. The quartz is white with occasional iron stains, and some pyrite.

Mine equipment: Consists of air compressor, machine drills, blacksmith shop and tools.

Mill: Blake crusher, two Challenge ore feeders, ten 1000-lb. stamps, and amalgamating plates. Six men are employed. James F. Meikel, superintendent.

Bibliography: State Mineralogist Report XIV, p. 896.

GOLD DREDGING.

The gold dredge now being constructed by the *Lewiston Dredging Company,* 7 miles above Lewiston on the Trinity River, is expected to be floated this month. The company has acquired four tracts of ground, which gives control of some three miles of ground along the Trinity River. The construction camp comprises a machine shop, equipped with machine-tools, a lodging house, a boarding house, office buildings and cottages. Water is pumped from a well by means of a Gould plunger pump having a capacity of 100 gallons per minute. A 10,000-gallon redwood tank gives 110 feet pressure for the water supply of the camp.

The *Gardella Gold Dredge,* which is located on the south side of the Trinity River below Lewiston, is operating steadily. Claude V. Enslow, superintendent.

The Trinity Gold Dredging Company, H. E. Chesboro, general manager, is operating their dredge 4 miles north of Lewiston on the Trinity River.

The Estabrook Dredge, near Carrville, which has been shut down for the past three years, is being repaired and it is reported that it will resume operations at an early date.

Lawrence Gardella, of Oroville, has taken a bond and lease on the Bragdon and the Fog & Lawrence tracts, which are situated in sections 18 and 7, T. 35 N., R. 7 W., on the Trinity River, 4 miles northwest of Minersville. This ground is being prospected with drills to determine its possibilities for dredging operations.

The Pittsburg-Comstock Company of Virginia City, Nevada, have recently acquired a stretch of placer ground on Canyon Creek between Junction City and Dedrick, known as the *Dannenbrink property,* and some adjoining claims. The company plans to start operations at an early date. F. M. Gibson, superintendent.

AUBURN FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

El Dorado County.

Losh Slate Quarry. Frank A. Losh, Placerville, Cal. Formerly considerable good black roofiing slate was produced in the Kelsey district, but at present this is the only active quarry. It is one-half mile by road from the Chili Bar bridge over the South Fork of American River and 4 miles from Placerville, and contains 18 acres covering 1250 feet along the strike of the slate beds. There was some production 30 years ago from the pit on the property beside the road to Kelsey.

Losh began work in August, 1921, and worked until December. He resumed work in May, 1922, and has been continuing steadily since, with six men employed early in November. The old pit is about 50 feet deep, 40 feet wide and 40 feet long. Losh is opening up the front to get a working face 20 feet below the present floor. Two men were splitting and trimming slate. Losh stated that he has been forced to turn away orders lately but is accumulating a stock and expects to be in the market the coming summer.

The slate appears to be of good quality, free from pyrite, and is sought by architects. A wide range of roofing sizes from 6″ by 12″ to 12″ by 24″ is being made. When in active operation it should be possible to greatly undersell eastern slate, with an equally good or better product. Slate roofs, properly applied, are everlasting, absolutely fireproof and far superior to the patented composition roofing materials that have been in common use recently. Slate sawed into various sizes can also be used for many other purposes such as blackboards, electric switchboards and insulation, and in building.

Other slate quarries in this county that have been described in our past reports are: California Slate Quarry, California-Bangor Slate Quarry, Chili Bar Quarry and Eureka Slate Quarry. The last named property, lying a mile south of Kelsey, is now nominally owned by the Sierra Slate Company, 4 and 6 White street, New York, but is under a heavy mortgage held by the Easton Bank of Easton, Pa. It was last worked in 1914-1915 by W. J. Dingee. At that time it was thoroughly equipped with quarrying machinery, five hoisting engines, two air compressors, saws, rubbing bed planers, slate makers' shanties and all accessories for operation on a big scale. A tramway was built from the quarry to Placerville, a length of 13,000 feet, to deliver the slate to the railroad for shipment, but the use of this is said to have been stopped by order of public officials, on account of danger where it crossed roads. Financial reverses in other lines of business in which the operator embarked are said to have contributed largely to failure. The quarry and all the equipment and a number of houses built for employes, have been lying idle for several years. This quarry and others have large reserves of good slate.

Placer County.

Work was resumed at the *Canada Hill mines* in the eastern part of the county, late in the summer.

Drilling with a Star drill rig was continued at the *Carmack Placer mines,* a mile from Canada Hill, during the past summer. Little progress was made as the work was done by men inexperienced in this class of prospecting.

Considerable good pay gravel has been blocked out in the lower workings of the *Glen Drift mine* in Duncan Canyon since last year's report and the gravel that was washed in the course of driving the adit ahead yielded well. The operating company has been handicapped by lack of funds and has been unable to work the mine to the best advantage.

The prospect adit of the *Gold Dollar Mining Company* at the *Blue Eyes* property on the side of Duncan Canyon has reached a length of 1400 feet and late in October was reported to show heavy boulders in the face.

The dredger of the *Pacific Gold Dredging Company* on the North Fork of American River near Applegate has been taken over by Matt Langstaff, Charles Geisendorfer, Dan Russell and other well-known residents of Placer County. They are working upstream toward the bridge on the Forest Hill road.

The buildings at the *Pine Nut mine* on Duncan Canyon were destroyed by fire during the summer.

Valley View Products Company. The water that issues from copper mines is not generally considered to be of any value except for the copper that may be recovered by precipitation, and miners as a rule avoid contact with it. Two enterprising men, Ed Gaylord and Judge J. B. Landis of Auburn, owners of the old Valley View mine, six miles northwest of Lincoln, have found that the water issuing from the mine gave good results in the external treatment of certain ailments, and numerous local people have testified to marked benefits obtained. The water is said to be helpful especially in cases of skin diseases, infected wounds and poison oak. It is being marketed under the name of Kilaga Water by the Valley View Products Company.

An analysis of the water in its natural strength was made by Smith, Emery and Company and appears below. This water is from a winze in an old tunnel. The lower workings have shown an ore with a low percentage of copper and considerable pyrite and zincblende.

Analysis of water from winze in Valley View mine:

		Parts per million
SiO_2	(Silica)	172.2
Fe	(Iron)	7555.2
Al	(Aluminum)	4362.8
Mn	(Manganese)	16.5
Cu	(Copper)	822.8
Zn	(Zinc)	2806.4
As	(Arsenic)	0.6
Ca	(Calcium)	247.0
Mg	(Magnesium)	1520.3
K	(Potassium)	118.5
H_2SO_4	(Sulphuric acid) as SO_4	48070.3
Volatile and organic matter and water of crystallization		13446.4
Total solids		81139.0

Specific gravity at 60° F., 1.0677.

Plumas County.

Feather Forks Gold Gravel Company at Little Grass Valley, nine miles north of La Porte, has made good progress during the short season of 1922. The property was described in the 1921 report. (See Marguerite mine.)

A sawmill, new hoist and 30-h.p. steam boiler have been installed during the summer. Two small reservoirs have been built to store water for washing gravel, and pipe lines have been built to bring water to the camp.

The gravel channel has now been followed 550 feet (October 27) and there is a total of about 1500 feet of underground workings. The gravel mined during the year is said to have averaged about $8 a yard. The production in June with 12 men was $6,500 and for 1922 to the end of October is placed at $20,000 by E. C. Miles, general manager. The company officials claim in their last report that gravel to the amount of 112,933 cars of 12 cubic feet capacity has been developed, of which about one-third is boulders. The gravel is said to pay in places to a height of 12 feet above bedrock.

To provide ventilation and a second exit, a second shaft 250 feet deep is being sunk 500 feet south of the working shaft. The mine operations are superintended by John and Gilbert McFarlane.

Jamison Mine. The sale of this old producer near Johnsville to the *Plumas Eureka Annex Company* was announced recently. The Jamison has been for many years one of the few producing quartz mines of the county and has a total production probably over $2,000,000. The price paid by the purchasers is said to have been $12,000. The property is valuable on account of its water rights which take in several small lakes nearby. Working cost has always been low on account of cheap water power, owning their own timber, and use of tunnels for drainage. In the past three years the mine has been leased, as the owners concluded they could no longer work it profitably because of the low grade of ore in sight and unsatisfactory labor conditions. There is not claimed to be any important amount of ore left in the mine. There is a heavy flow of water coming from the drain tunnel, which is in poor shape. The purchasers have been doing surface repair work during the summer.

Maxine Mine. The surface plant at this drift mine, which adjoins the Feather Fork property in Little Grass Valley, was destroyed by fire recently and the mine is idle, as winter is too near to permit rebuilding this year. The company is being organized. The mine was described in the 1921 report.

Morington Mine. This property and the plan conceived for working it were described by the writer in the 1920 report, and the question was there raised as to whether or not the plan to be followed could be successful. Since the above report was written, two summers have been spent in attempting to divert the water from the river bed and to prospect and work the gravel in the channel. During the past summer, a crevice at the junction of Willow Creek was prospected but did not produce. One other place was prospected by shaft, but this also was disappointing. The latest report is that the majority stockholders have decided to give up the project. It is estimated that about $160,000 was raised by the sale of stock and expended upon the property. Some of the minority stockholders believe that the property is worth working by other methods. It is true that the work so far done has not prospected the ground.

Plumas Eureka Mine. The mill at this well-known property at Johnsville has been operated only about two months in 1922. There is claimed to be a good reserve of ore in the Mohawk Flat vein. The recent work on this has been through a raise 534 feet long from the Eureka tunnel and the method of working has proven difficult and it has been hard to keep a crew at work. The Mohawk tunnel, about 1000 feet long, could be cleared out and offers a better entry, it is believed, for exploiting this ore body, which is held to be of sufficient size and value to warrant the work. Chas. D. Stark, Jr., is superintendent.

Plumas Eureka Annex Company has made little progress during the year in developing their claims southeast of the Plumas Eureka mine.

COPPER MINES.

Beardsley Copper Company. The mill on this company's claims was completed this fall and has been waiting for a water supply to begin operations. The property was described in the 1920 report.

Engels Copper Mining Company. A holding company, called the *California Copper Corporation,* has lately been formed to stabilize the control of the stock of this company. The stock of the holding company will be exchanged for shares of a like par value in the Engels Copper Mining Company. It is stated that the holders of a majority of the Engels stock have already signed the agreement for the exchange. J. F. Humburg is president, and I. J. Truman, Jr., is secretary of the new company, and E. E. Paxton, for some years general manager of the Engels concern, is a director.

The mines and mill have continued active on an enlarging scale during the year. No. 10 tunnel is considerably over half finished and it is estimated that it will be completed by June 15, 1923, to the point where a connection will be made with No. 7 level. When the workings are thus connected, it is planned to abandon the tramway used now to deliver from the Engels mine to the mill.

The company has been employing about 550 men the past summer. An average of about 1,000 tons of ore has been milled daily. The report for the first half of 1922 showed a total of over 178,000 dry tons of ore crushed, 11,816 dry tons of concentrate produced, from which 6,763,783 lb. of copper, 98,097 oz. silver and 919 oz. gold were recovered. The May output of copper was 1,270,581 lb. and a low operating cost record of 10.81 cents per lb. exclusive of depreciation, depletion, etc., was claimed. The total operating and development cost was given in the last report as 12½ cents a pound, as compared with 19.58 cents a pound for 1918. Based on the figures published in that report, the company should produce about $2,000,000 this year, and is thus seen to be the largest producer among the mines of the state.

Walker Copper Mine has been operating at the capacity of the mill, about 160 tons a day. Since the 1920 report, in which the writer described the mine and mill, there was temporary cessation of work. Since resumption, the No. 8 or bottom adit has been connected by raise with the upper workings and work is now done through No. 8. The tramway was completed shortly after our 1920 report. This tramway is nine miles long, connecting with the Western Pacific Railway at Spring Garden. It carries sixty buckets 1500 feet apart and delivers 800 pounds of concentrate every three minutes. An hour and a half is required for the buckets to make the trip one way.

Yuba County.

A. C. Bates Mine is three-quarters of a mile southeast of Brownsville on Dry Creek and contains two parallel claims on parallel ledges 300 feet apart, striking nearly north. On one ledge near the creek a shaft has been sunk 110 feet on the vein with 10 feet of drift at the 100 foot level. This shaft is now nearly full of water. An adit has been driven east 142 feet at a point 250 feet south of the shaft and the owner estimates it has 125 feet to go to reach the second vein. A. C. Bates, the owner, states the walls of syenite and diabase are 11 feet apart in the bottom of the shaft.

Bates has built and is experimenting with a small mill of his own invention which he calls a high speed perpendicular arrastra. It consists of a series of disc drags resting loosely on each other, the bottom muller working on an iron bed. A rotary and rocking motion at the rate of 90 r.p.m. is used. A 3-foot water wheel furnishes power, using water under 40-foot fall from a ditch crossing the claims. He is crushing a few hundred pounds of ore a day from the shaft just above the water level, and claims to be making wages while he perfects the details of his mill. For saving the concentrate, he is using a small concentrating device also of his own invention, employing a series of baffles in a sluice, but not yet perfected to the point of doing good work.

B. A. C. Mine is still in litigation. The latest decision was in favor of E. A. Hoeppner of Brownsville, who spent a large sum in equipping and prospecting the property, without success.

The property is one-half mile north of Brownsville. It has been developed by an incline shaft 535 feet deep on the dip of vein, giving a vertical depth of 332 feet. The vein strikes N.N.W. and dips 34 to 37 degrees east. The following levels and drifts have been run:

No. 1—north 200 feet, south 400 feet
No. 2—north 80 feet, south 440 feet
No. 3—north 20 feet, south 580 feet
No. 4—north 215 feet, south 115 feet
No. 6—north 25 feet, south 50 feet
No. 7—north 90 feet, south 325 feet
No. 8 (from winze)—20 feet

According to an assay map of the mine, a few small areas assayed well, but in general the recorded results are too low to pay, especially in No. 7 level. There is some ore indicated in the upper levels, but whether or not this would be sufficient to pay the expense of reopening the mine and getting it out is a question, the answer to which depends on the condition of the drifts after unwatering and the amount of water to be pumped. A heavy flow of water was encountered in the bottom and was not brought under control when the mine was closed.

The property is equipped with a good 5-stamp mill, tube mill and cyanide plant, planned to handle 50 tons daily. Very little ore from the mine was crushed in it.

Beik Prospect. Wm. Beik of Challenge, and Jos. Supple of Portland, Oregon, owners. This contains 80 acres in Sec. 9, T. 19 N.; R. 7 E.; one-half mile from Woodleaf Beik reports that 50 tons of ore were taken from a hole 20 feet long by 20 feet deep. Thirty tons of this was milled at the Horseshoe mill and according to Beik yielded $305, besides which some gold still remained on the plates when the mill was burned. The vein is said to be 3 feet wide, strikes nearly north and dips vertically. No work is being done now.

Golden Arrow Mining Company. M. A. Miller, president, office in Oakland, Cal. The property was formerly called the *Old Spanish mine* and had an interesting early history, but no definite record is available of the output. It comprises 27 acres in the N.W. ¼ of Sec. 32, T. 19 N.; R. 6 E.; for which patent is being sought by O. N. Pauly.

The old surface workings were about 50 feet deep for about 200 feet on the vein. A new drift is being run on the vein 90 feet below the surface and is now (October 28) 300 feet long. The vein pinches and swells and is up to 3 feet wide.

Horseshoe Mine is a mile and a half northeast of Challenge in the S.W. ¼ of Sec. 21, T. 19 N.; R. 7 E.; and is leased to Jos. Supple of Portland, Oregon.

A crosscut has been run 600 feet to the vein and there is a drift 220 feet north on the vein, which is about 20 inches wide, strikes north and dips west. A depth of about 200 feet below the surface has been reached in the drift. Both walls are hard green schist.

The mill, which had previously been burned down, was rebuilt late in 1921. It contains 5 medium weight stamps and power is furnished by a 25-h.p. steam engine, using wood for fuel. Since it was rebuilt, 37 tons of ore has been milled and is said to have yielded from $3 to $8 a ton, in different small lots. Two men are at work putting up a raise about 20 feet beyond where the adit strikes the vein. This has about 50 feet to go to connect with an old shaft supposed to be 90 feet deep.

Kingbird Mine. This mine, which was briefly described in the 1921 report, has been idle since March, 1922. It is a mile northeast of Clipper Mills.

The mill was operated from December, 1921, to March, 1922, and the tunnel reached a length of 575 feet. Gil Peyton, the former superintendent, departed for the east early in the year and took the original records. According to the foreman, Goken, about 700 tons of ore averaging $7 a ton was milled. Kingbird Mines Company, Lincoln Bldg., Philadelphia, was organized to operate the property but has done no work since March.

Yuba Gold Mining Company. J. N. Sobrero, president, at the mine. C. A. McCumber, secretary, office, 314 Montgomery Street, San Francisco, Cal.

This company has been organized to reopen the old *Hansonville mine,* beside the Marysville-La Porte road, one-quarter of a mile from Rackerby. The old shaft is 220 feet deep, according to such fragmentary information as can be had, with levels at 80 and 140 feet, but the mine has been idle so long that no definite data are available. The vein strikes northeast and dips 45 degrees northwest. Two mills have been burned down on the property, and it has the local reputation of having produced good ore and of always paying its own way. The present operators claim to have reports showing the mine produced 6100 tons of ore averaging $12 a ton. The men in charge of the work at the mine are experienced miners who have been operating the Jamison mine in Plumas County for several years under lease. They are cleaning out the old shaft.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

Napa County.

Oil Possibilities in Berryessa Valley.

Subsequent to the publication in 1921 of Vander Leck's report on the oil possibilities in the Sacramento Valley (including the eastern slope of the Coast Ranges and foothills of the Sierra Nevadas) as a part of his work on the Petroleum Resources of California, issued as Bulletin No. 89 of the State Mining Bureau, there has been considerable new 'wildcat' drilling started in this northern territory.

So-called 'wildcat' drilling has been an important factor in keeping both the United States and California well in the lead in the production of petroleum in recent years, and the development of prospective new fields in northern California has attracted the attention of the public in growing measure as operations have progressed.

For the purpose of outlining the development work under way, and the results attained to date, by companies that have elected to drill in Napa County, the writer spent several days during October in making a huried reconnaissance of Berryessa Valley where some seven wells are in process of drilling.

A possible oil-bearing area of Cretaceous formation in northeastern Napa County is shown on the map of California accompanying Bulletin No. 89.

Situated within this formation lies the Berryessa Valley 'wildcat' oil field. The geology of this area of Cretaceous sediments, as a whole, and the factors favorable and unfavorable to the accumulation and production of oil are discussed by Vander Leck in the above bulletin. A generalized cross-section of the area along a northeasterly line passing close to Knoxville and Rumsey, Yolo County, is also given. This line just cuts the northernmost part of Napa County. No features of the geological structure of Berryessa Valley, farther south, in the vicinity of Monticello, are given, and as there was no activity at the time, the discussion of oil indications in the central portion of the valley was limited to the listing of records of wells drilled some twenty years ago. These were the Harris well, 400 feet in depth, in Sec. 29, T. 9 N., R. 3 W.; and the Fearless well in Sec. 26, T. 9 N., R. 3 W., which was drilled to a depth of 1475 feet. Showings of oil were obtained in both these wells.

Berryessa Valley is comparatively isolated and surrounded by high ridges, that on the eastern side forming the boundary between Napa and Yolo counties. This ridge rises abruptly from the valley floor and is composed of upturned Knoxville carbonaceous shales, sandstones, and minor beds of pebbly conglomerate dipping steeply to the east. The formations are cut by the deep canyon of Putah Creek at a point a little south of Monticello, where a large part of the series is exposed to view.

The enclosing ridge on the west is composed of the Franciscan formation. Against this the upturned Knoxville sediments contact.

Encouraged by strong seepages of oil in the Knoxville formation along this contact, and after study of the structural features to determine the most likely points at which oil could accumulate, large acreages throughout the valley were secured by oil operators for the purpose of developing a producing field.

The principal holdings are those of the Griffiths Oil Company and the Associated Oil Company of California, both of which started active development this year.

The Griffiths Oil Company drilled four prospect wells on steeply dipping monoclinal structure in Sec. 29, T. 8 N., R. 3 W., and obtained a high-grade paraffin base oil in a ten-inch hole at a depth of 165 feet. A small pump has been placed on this well.

The Associated Oil Company is drilling, also in section 29, about one-half mile south of the Griffiths discovery well. In their well No. 2, high gravity paraffin oil was obtained in quantity, variously estimated as making from one to ten barrels daily, at 1365 feet. Drilling was continued with three shifts daily, and at present this well is down 1700 feet.

From section 29, the oil-bearing formations penetrated strike about N. 30° W., outcropping at points slightly closer to the Cretaceous-Franciscan contact on the west, as they extend northward.

About three miles north of the discovery well the level floor of Berryessa Valley is much constricted by a series of low rounded hills extending from the base of the Franciscan to the road going to Monticello, and reaching north and south for several miles. This generally elevated portion appears to be made up of one or more transverse folds. On the south, where exposed along the banks of Sugarloaf Creek, the strata show a series of small anticlinal and sinclinal folds with dips east and west of low angle.

A half mile north of Sugarloaf Creek, about where the east line of section 7 would run, there is an outcrop of sandstone and shale dipping northward at a low angle, exposed in a draw. From one-quarter to one-half mile farther north, a bed of fossiliferous limestone is exposed, dipping south at a flat angle. Still farther north, toward 'the island' there are other exposures in small gulches, which substantiate the view that in general the formations in this vicinity form several transverse easterly and westerly folds whose axes are approximately level, modified by minor folding at right angles.

This structure seems to offer advantages in its retentive features, not generally found in the Berryessa Valley field, where steeply dipping monoclinal structure largely prevails; and if there are accumulations of oil, in quantity, in the district, it is extremely probable that a thorough prospecting of the area along these transverse folds by wells of sufficient depth to penetrate the oil-bearing formations will be rewarded by a highly remunerative production.

The Griffiths Oil Company has a complete standard rig capable of drilling to a depth of 5000 feet at their well No. 5 located on this structure in what would be the E. $\frac{1}{2}$ Sec. 7, T. 8 N., R. 3 W.

At present this well is down 2000 feet, at which depth there is some gas coming from the hole. Gas and showings of oil were encountered above this depth, but the principal oil-bearing formation is not expected to be reached under 3400 feet, and drilling is being continued.

The Sugar Loaf Oil Company's well is being drilled in T. 8 N., R. 3 W., on the east side of Putah Creek slightly north of east from the Griffiths Well No. 5 and about one mile south of the town of Monticello.

Also on the eastern side of the valley, and about six miles north of Monticello, the Wreden Oil Co. of Los Angeles is drilling.

The Napetro Producing Company, controlled by the Humboldt Trading Company, also has a drill in operation in the Berryessa field in Sec. 20, T. 8 N., R. 3 W.

Berryessa Valley proper terminates on the south about opposite the point where Putah Creek turns eastward and cuts its way through the Vaca Ridge. The road south from the valley follows Steel Canyon until the canyon opens out into the smaller Capell Valley near the center of T. 7 N., R. 3 W. The Capell Valley Corporation is drilling here on Section 16. This well is approximately 4½ miles south of the Associated Oil Company's well and the Griffiths discovery well in Berryessa Valley.

Unfortunately the U. S. Geological Survey topographic maps do not include Berryessa Valley, the northern boundary of the Napa quadrangle coinciding with the line between townships 7 and 8 north; neither is there a geological folio covering this territory. A large scale topographic map alone would be of much assistance in gaining a comprehensive view of the relative positions of the various horizons exposed at different points and their bearing on the structural geology.

Although it is probably true that petroleum in 'gusher' quantities is not likely to be found in the Cretaceous formations in California, the oil so far obtained in this formation is a high-gravity paraffin base oil varying in color from amber to light green or white, and much of it resembles a refined product as it comes from the well, more than it does a crude oil.

A matter of particular interest, in connection with the showings of oil in the Berryessa Valley, is the report that the oil contains ichthyol.

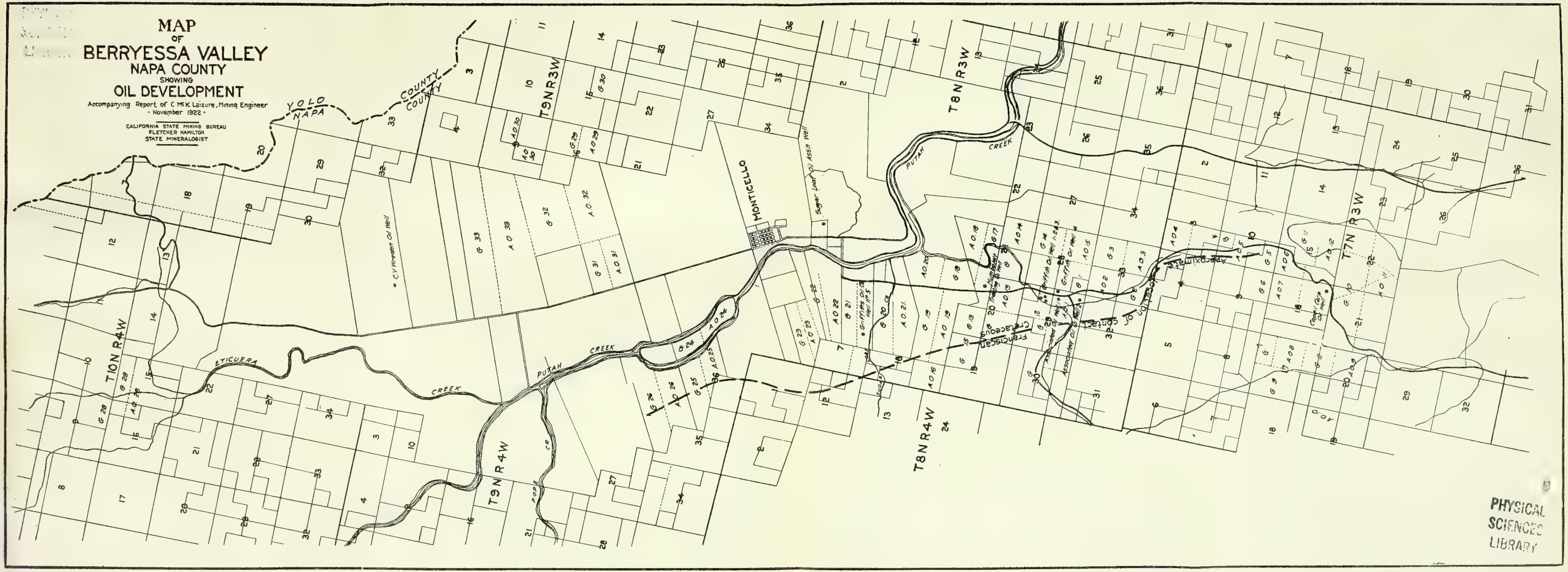
This has been substantiated by an analysis of the oil from the Griffiths Oil Company's well No. 1, made by Wrana, King & Co., which showed 3.57 per cent ammonium ichthyol-sulphonate.

Ichthyol, according to Collom (see page 107 *ante*), is employed in pharmaceutical practice as an antiseptic and medicament. When used in an ointment, it is said to have great penetrating qualities.

The scarcity of true ichthyol in the United States has resulted in much research work seeking to extract ichthyol oil from domestic bituminous material. Thus far, true ichthyol has been produced only in Austria, and since the war it has been increasingly difficult to obtain. American-made substitutes, synthetically derived, sell for from $3.50 to $5 per pound. True ichthyol ranges much higher in the New York market. It was quoted and sold at from $12 to $36 per pound during 1916 and 1917.

The development of even a moderately producing oil field in the Sacramento Valley area would be an asset of much value to the northern part of the state.

Locally, in the Berryessa Valley, operations to date show that excellent strides have been made in the short time since activities commenced, and the results so far obtained may well encourage companies drilling here to put forth every effort to prove up their holdings.



MAP OF BERRYESSA VALLEY NAPA COUNTY SHOWING OIL DEVELOPMENT

Accompanying Report of C. McK. Laizure, Mining Engineer
· November 1922 ·

CALIFORNIA STATE MINING BUREAU
FLETCHER HAMILTON
STATE MINERALOGIST

PHYSICAL SCIENCES LIBRARY

LOS ANGELES FIELD DIVISION.

M. A. Newman, Mining Engineer.

Inyo County.

Pacific Coast Borax Company. The main borax deposits of this company are situated near Ryan, 20 miles northwest of Death Valley Junction. At Death Valley Junction the company has a large crushing and concentrating plant to which 300 tons of second-class ore is shipped per day from the different mines. Ryan is connected by a narrow gauge railway with Death Valley Junction.

The borax occurs both as colemanite and ulexite, the former being the hydrous borate of calcium ($Ca_2B_6O_{11}5H_2O$), while the latter is the hydrous borate of calcium and sodium ($NaCaB_5O_98H_2O$).

At the concentrating plant, Stebbins dry concentrators are used to separate the shaly material from the borax with excellent results. The conditions here are ideal for dry concentration as the ore passes through the revolving roasters before being concentrated, thus being absolutely without moisture when it is ready for the Stebbins machines. The company is now building a refinery at Wilmington, California.

It is a pleasure to note that the company has provided excellent housing accommodations for all of its employees and has succeeded in creating a general spirit of contentment at the camp. About 300 men are employed at the mine and mill.

Maj. J. Boyd is superintendent of the mine and F. W. Corkill, mill superintendent.

Paddy Pride Mine. Situated nine miles west of Zabriskie, a station on the Tonopah and Tidewater Railroad.

Shipping at present one car of high grade silver-lead ore per month.

Tecopa Consolidated Mining Company. This company owns silver-lead deposits nine miles southeast of Tecopa, a station on the Tonopah and Tidewater Railroad. It has a 100-ton concentrating plant at Tecopa. Owing to the excellent market for lead today, it is at present increasing its scale of operations.

San Bernardino County.

Allured Copper Mine. This property is situated 12 miles northeast from Cima, a station on the Salt Lake branch of the Union Pacific. It consists of nine claims. There are several veins occurring in a limestone formation. The copper occurs as a carbonate running 20 to 25 per cent copper. Copper sulphides also are found, these running 7 per cent copper. It is stated that this property will soon be developed by Mr. W. A. Allured and associates.

California Rand Silver, Inc. This company has declared dividend No. 34 for 2 cents a share, and special dividend No. 9 for 10 cents a share, the two calling for a distribution of $153,000. This is the sixth extra dividend during 1922, the total dividends to date for the year being 82 cents per share or $1,049,600. The total dividends distributed by the company in the three years of its existence are $1.65½ per share or $2,118,400.

Extraction and Progress.

During the month of October the total extraction from the mine footed up 10,151 tons, distributed as follows:

Milling ore	5,250 tons
Shipping ore	1,166 tons
Waste	3,735 tons
Total output	10,151 tons

Also there was a production of 320,460 gallons of water from shaft No. 2. Within the last few days, however, this water flow has decreased by fifty per cent.

The total advancement for the month was 1,711 feet, as follows:

Raises	110 feet
Crosscuts	154 feet
Drifts	1,290 feet
Shafts	74 feet
Stations	83 feet
Total	1,711 feet

Mill Operations for October.

Total ore milled		4,729 tons
Daily average for 31 days		152.55 tons
Daily average for running time		166.65 tons
Average gold heads	$1 87	
Average silver heads	17 34	
Total value		$19 21
Average gold tails	$0 40	
Average silver tails	1 43	
Total value		$1 83
Average gold extraction		78.60 per cent
Average silver extraction		91.75 per cent
Average total extraction		90.48 per cent
Recovery, per ton		$17 38
Total recovery on 4729 tons		82,190 02
Average concentrate value, per ton		$319 00
Tons of concentrates produced at $319		257.65
Tons of concentrates shipped to smelter		256.00

By the end of November it is expected that the mill, with its new equipment, will be treating 200 tons of ore daily. But owing to the necessity of rapid marketing of the product, due to the limitations of the Pittman Act, it was decided at the meeting of the board of directors, on November 2, to still further increase the capacity of the mill so as to handle 400 tons of ore daily. Work in that connection will be begun at once under the direction of Mill Superintendent Coleman, with the hope that the new machinery will be in operation by February 1. It is estimated that the cost will be $60,000.

Financial.

During the month 941 tons of ore were shipped to the smelter in addition to the concentrates, and smelter returns totaled $146,785.10.

After paying the dividends named above, the company has cash on hand in the sum of $313,707.06.

California Rock Salt Company. This company is working a deposit of rock salt four miles southeast of Saltus, a station a few miles east of Amboy on the Santa Fe Railroad. The deposit occurs in an old lake bed and is overlaid by about 3 to 4 feet of overburden, consisting of sand and gravel which is removed by scrapers. The salt deposit which is 8 feet thick is then mined, the salt being hauled to Saltus over a narrow-gauge railway for crushing. At present the company is extracting about 1000 tons per month. It is sold mainly to ice cream manufacturers. The company has offices at 2436 Hunter street, Los Angeles, with officers as follows: president, Mrs. Lathrop; manager, Mr. Lathrop; superintendent, M. Staples.

Olympus Gold Mine. This property is situated 22 miles north of Daggett in the Paradise Range at an elevation of 2200 feet. There are several veins in a granite formation that course northwest and southeast, dipping at an angle of about 30 degrees to the northeast. The property is developed by tunnels and incline shafts. The vein varies in width from 5 feet to 25 feet. The company claims there is developed at least 50,000 tons of gold ore which will run approximately $6 per ton.

At the present time a Victory ball mill having a capacity of 50 tons per day is being installed. Mr. M. W. H. Williams and H. Galerone are respectively president and superintendent of the company.

Randsburg Silver Mining Company (Coyote). This company has started to ship its high grade ore and to date five cars have been sent to the Humboldt smelter in Arizona. The ore averages about 100 ounces per ton. It is common knowledge in Randsburg that litigation over apex and extra-lateral rights may be commenced any day by the California Rand Silver, Inc. Yet it is just possible that, as no injunction has been asked for by the California Rand Silver to stop shipments by the Coyote, some understanding has been reached by these two companies to avoid costly lawsuits which would primarily benefit only the various lawyers and geologists who would be retained by both sides.

Silver Bow Mine. This property is situated in the West Calico district about 14 miles north of Daggett, a station on the Santa Fe Railroad.

The vein strikes approximately east and west, dipping at an angle of 30 degrees to the north. It occurs in what may be called a porphyritic rhyolite. An incline shaft has been sunk to a depth of 200 feet on the vein with levels at a depth of 120 and 160 feet, each being about 90 feet in length. The vein averages 4 feet in width, and the owners claim it will run 20 ounces silver per ton. The vein filling consists largely of calcite and the silver mainly occurs both as a chloride and bromide, though also found in lead carbonate and galena which occur in small quantity. The property is owned by W. A. Swan, Ed Reiber, R. Finley and Arthur Kunze of Daggett.

It may be of interest to note that the old Calico Mining District, which is only about three miles south of West Calico, produced about 10,000,000 ounces of silver during its period of activity, 1881 to 1893, when silver averaged $1 per ounce. In 1892, silver dropped to $0.87 and in 1893 to $0.78 per ounce, with the result that only mines having high grade ores could continue to operate.

As an example of the costs and metallurgical losses which prevailed at Calico during its most prosperous period, the following may be illuminating.

The *King Mine* of this district was operated during 1883, 1884, 1885 and 1886. It produced 37,000 tons having a gross value of $1,355,000 or $36.61 per ton. It paid dividends of $450,000 or $12.16 per ton. If the tailing loss amounted to 20 per cent or $7.32 per ton, the cost of mining, milling, haulage and general expense must have been $17.13 per ton. It can readily be seen why those mines which had exhausted their richer ore bodies could not operate when silver dropped to $0.78 in 1893.

The silver status at present is somewhat analogous to that which existed in 1891. Under the Pittman Act, silver is bought by our government at $1 per ounce. This act has but a few more months to run. At its conclusion, the law of supply and demand will regulate the price of silver and we may then expect $0.65 to $0.70 silver. It is therefore a serious question to those opening up silver prospects to know how low grade a silver deposit they may be able to operate upon.

Vanderbilt Mining Company. This company recently acquired the holdings of the Green Campbell Estate, situated at Vanderbilt, five miles east of Ivanpah, a station on the Union Pacific (Salt Lake) Railroad. These properties have been shut down for the last twenty years. The present company has unwatered the mines to the 200-foot level and cleaned out the old drifts and other workings. They claim to have on the 200-foot level one shoot of ore 140 feet long with an average width of nine feet, assaying $23 per ton. Also another shoot that is 400 feet long, 3 feet wide, that will assay $20 per ton. The values are mainly gold. The company proposes to sink the Rose Shaft 150 feet deeper or to the 300-foot level.

The property looks very promising from the development point of view and gives promise of again becoming a large producer. C. C. Barclay, president and general manager; J. J. Hurlburt, vice president; P. V. Hammon, secretary. C. A. Vanderbilt, treasurer. Offices at 715 O. T. Johnson Building, Los Angeles.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. COLLOM, State Oil and Gas Supervisor.

From October 7, 1922, to and including November 11, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Salvia Oil Company	24	20	11	21	Coalinga
KERN COUNTY:					
Pacific Oil Company	35	30	24	105	Elk Hills
Orval Overall and associates	33	25	20	1	Lost Hills
Associated Oil Company	22	3	23	61	Midway
C. C. M. O. Company	26	31	22	26	Midway
Fresno-Taft Oil Company	35	32	23	1	Midway
Honolulu Cons. Oil Company	6	32	24	15	Midway
Midland Oilfields Co., Ltd.	24	31	23	2	Midway
Midway Vivian B. Oil Company	35	32	23	3	Midway
Morse & Reed	2	31	22	1	Midway
Pacific Oil Company	15	32	24	89	Midway
Record Oil Company	28	31	23	6	Midway
Heard & Painter Company	3	11	24	24	Sunset
E. M. Byers	2	27	18	New 1	-------------------
LOS ANGELES COUNTY:					
Standard Oil Company	18	3	10	M. C. 95	Coyote Hills
Standard Oil Company	18	3	10	M. C. 96	Coyote Hills
Apex Petroleum Corporation	19	4	12	Morris 1	Long Beach
Bartholomae Oil Syndicate	29	4	12	2	Long Beach
Black Diamond Oil Trust	30	4	12	Murchison 1	Long Beach
F. E. Brittain, Tr.	19	4	12	3	Long Beach
Bush-Voorhis Oil Company	19	4	12	6	Long Beach
Cady & McGee	20	4	12	1	Long Beach
Cal-Mex Oil and Refining Co.	19	4	12	Kirkpatrick 2	Long Beach
Calmont Oil Company	19	4	12	4	Long Beach
Dabney Oil Syndicate	29	4	12	21	Long Beach
Downs-Butterfield Syndicate	19	4	12	1	Long Beach
R. W. Edens	19	4	12	Butler 7	Long Beach
Fred B. Foster & Company	19	4	12	Berry 1	Long Beach
Fred B. Foster & Company	19	4	12	Butler 1	Long Beach
General Petroleum Corporation	19	4	12	Jonah 2	Long Beach
General Petroleum Corporation	20	4	12	Scoco 4	Long Beach
General Petroleum Corporation	20	4	12	Scoco 3	Long Beach
George F. Getty	20	4	12	Malloy 5	Long Beach
H. & T. Syndicate	19	4	12	1	Long Beach
Hagar & Deniston	19	4	12	3	Long Beach
Hagar & Deniston	19	4	12	2	Long Beach
Henderson Petroleum Syndicate	20	4	12	Barry 1-A	Long Beach
Henderson Petroleum Syndicate	29	4	12	Lekas 2	Long Beach
Hub Oil Company	19	4	12	Janich 1	Long Beach
Hub Oil Company	19	4	12	Rissman 1	Long Beach
Industrial Oil Syndicate, No. 2	19	4	12	1	Long Beach
Interstate Oil Corporation	19	4	12	Olson 1	Long Beach
McIntyre Bros.	19	4	12	1	Long Beach
Carl Maier	19	4	12	1-A	Long Beach
Carl Maier	30	4	12	Harris-Maier-Brayton 1	Long Beach
Marine Oil Corporation	19	4	12	5	Long Beach
Monrovia Oil Company	29	4	12	1	Long Beach
Moore-Tobias	19	4	12	Neet 1	Long Beach
Pacific Corporation	29	4	12	16	Long Beach
Pacific Corporation	19	4	12	5	Long Beach
E. A. Parkford	24	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	29	4	12	Griswold Two 1	Long Beach
Progressive Burnett Syndicate	30	4	12	2	Long Beach
W. R. Ramsey	29	4	12	1-B	Long Beach
Shell Company	29	4	12	Andrews 4	Long Beach
Shell Company	29	4	12	Hamilton 1	Long Beach
Shell Company	29	4	12	Cossboom 2	Long Beach
Signal Hill Drilling Company	30	4	12	Benwell 2	Long Beach
Simplex Petroleum Corp.	19	4	12	Garrison Pier 1	Long Beach
Superior Oil Company	29	4	12	Crew 2	Long Beach
Superior Oil Company	19	4	12	Britton 2	Long Beach
Jos. K. Tobin	20	4	12	1	Long Beach
Transport Oil Company	30	4	12	3	Long Beach
Umpire Petroleum Corporation	29	4	12	Grimes 1	Long Beach
Union Oil Company	30	4	12	Long Beach Com. 7	Long Beach
Wellton Oil Syndicate	19	4	12	1	Long Beach

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES CO. (Continued):					
Standard Oil Company	9	4	14	Felker Com. 1	Redondo
Amalgamated Oil Company	5	3	11	Butterworth 5	Santa Fe Springs
Amalgamated Oil Company	6	3	11	Dewenter 2	Santa Fe Springs
Amalgamated Oil Company	6	3	11	Jordan 1	Santa Fe Springs
Amalgamated Oil Company	5	3	11	Butterworth 2-A	Santa Fe Springs
Amalgamated Oil Company	5	3	11	Butterworth 6	Santa Fe Springs
Are Bee Oil Syndicate	7	3	11	1	Santa Fe Springs
Coalinga Mohawk Oil Company	6	3	11	Batson 2	Santa Fe Springs
Co-Operative Petroleum Syn.	7	3	11	1	Santa Fe Springs
Ferdon & Vurpillat Oil Land Syndicate	32	2	11	1	Santa Fe Springs
Fullerton Oil Company	4	3	11	Gum Grove 1	Santa Fe Springs
General Petroleum Corporation	5	3	11	Santa Fe 37	Santa Fe Springs
General Petroleum Corporation	32	2	11	Pacific 1	Santa Fe Springs
George F. Getty	6	3	11	Shafer 6	Santa Fe Springs
George F. Getty	6	3	11	O'Connell 7	Santa Fe Springs
George F. Getty	6	3	11	8	Santa Fe Springs
George F. Getty	6	3	11	9	Santa Fe Springs
Gilbert Petroleum Corporation	7	3	11	1	Santa Fe Springs
Globe Petroleum Corporation	6	3	11	2	Santa Fe Springs
A. L. Irish	5	3	11	1	Santa Fe Springs
Jameson Petroleum Company	6	3	11	6	Santa Fe Springs
Jameson Petroleum Company	6	3	11	5	Santa Fe Springs
C. C. Julian	1	3	12	4	Santa Fe Springs
Kirkpatrick Petroleum Co.	6	3	11	2	Santa Fe Springs
McKeon Drilling Company	6	3	11	Woodard 1	Santa Fe Springs
McKeon Drilling Company	6	3	11	Bossick 1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Mattern Three 1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Mattern Three 2	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 1	Santa Fe Springs
Russel Petroleum Company	1	3	12	1	Santa Fe Springs
Santa Fe Dome Oil Company	5	3	11	1	Santa Fe Springs
Schaff-Noble Oil Syndicate	6	3	11	1-A	Santa Fe Springs
Schaff-Noble Oil Syndicate	6	3	11	2	Santa Fe Springs
Shell Company	31	2	11	GHN Com. 4	Santa Fe Springs
Shell Company	5	3	11	Slayden 1	Santa Fe Springs
Standard Oil Company	31	2	11	Santa Gertrudes 2	Santa Fe Springs
Standard Oil Company	6	3	11	Koontz 1	Santa Fe Springs
Standard Oil Company	5	3	11	So. Whittier Com. 7	Santa Fe Springs
Standard Oil Company	5	3	11	So. Whittier Com. 6	Santa Fe Springs
Union Oil Company	31	2	11	Bell 3-A	Santa Fe Springs
Union Oil Company	6	3	11	Bell 12	Santa Fe Springs
Union Oil Company	6	3	11	Bell 13	Santa Fe Springs
United States Royalties Co.	6	3	11	1	Santa Fe Springs
Whiston & Cox Oil Company	7	3	11	1	Santa Fe Springs
Whitley Oil and Refining Co.	16	2	11	8	Whittier
Artesia Oil Company	25	3	12	1	------------------
Calpetro Producing Syndicate	22	3	12	1	------------------
J. J. Rekar	18	1	2	1	------------------
Ventura Oil Syndicate	25	1	12	1	------------------
MERCED COUNTY:					
Henry L. Kims	31	9	9	1	------------------
ORANGE COUNTY:					
Huntington Beach Oil and Gas Company of Oregon	2	6	11	1	Huntington Beach
Globe Petroleum Corporation	34	5	11	3	Huntington Beach
Miley Keck Oil Company	2	6	11	31	Huntington Beach
Miley Keck Oil Company	2	6	11	30	Huntington Beach
Miley Keck Oil Company	2	6	11	18	Huntington Beach
Miley Keck Oil Company	2	6	11	29	Huntington Beach
Miley Keck Oil Company	34	5	11	32	Huntington Beach
Olig Crude Oil Company	2	6	11	2	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Brown 1	Huntington Beach
Petroleum Midway Co., Ltd.	2	6	11	Columbia 2	Huntington Beach
Shell Company	34	5	11	Slater 2	Huntington Beach
Standard Oil Company	13	6	11	Surf 1-A	Huntington Beach
Standard Oil Company	34	5	11	Bolsa 12	Huntington Beach
Standard Oil Company	34	5	11	Bolsa 11	Huntington Beach
Standard Oil Company	27	5	11	Orange County Title Co. 1	Huntington Beach
Union Oil Company	34	5	11	Copeland 18	Huntington Beach
Union Oil Company	34	5	11	Brooks 5	Huntington Beach
Union Oil Company	1	6	11	Newland 3	Huntington Beach
Union Oil Company	35	5	11	Copeland 17	Huntington Beach
Union Oil Company	35	5	11	Copeland 13	Huntington Beach
Western Star Oil Company	35	5	11	Savage 1	Huntington Beach
Amalgamated Oil Company	33	3	9	Kammerer 2	Richfield
Union Oil Company	29	3	9	Chapman 15	Richfield
Union Oil Company	29	3	9	Chapman 16	Richfield

Company	Sec.	Twp.	Range	Well No.	Field
RIVERSIDE COUNTY:					
Matthews, Rowland & Dalziel	12	3	4	1	-------------------
SAN BENITO COUNTY:					
Hamiltonian Oil Company	19	16	11	1	-------------------
SAN BERNARDINO COUNTY:					
Del Rosa Oil and Gas Co.	13	1	14	1	-------------------
TEHAMA COUNTY:					
Tehama County Oil Co. and Hooker Dome Oil Company	24	26	4	1	-------------------
TULARE COUNTY:					
Big Four Oil Syndicate	29	23	27	1	-------------------
Tulare Oil Company	1	20	24	1	-------------------
VENTURA COUNTY:					
Fred Norton	2	4	22	1	Ojai
Stearns-Maney Oil Company	28	4	23	1	Ojai
Fortuna Oil Company	13	4	19	15	Piru
Oak Ridge Oil Company	13	3	21	Harvey 10	South Mountain
Santa Paula Oil Company	18	3	20	Santa Paula 13	South Mountain
Associated Oil Company	28	3	23	Lloyd 6	Ventura
Associated Oil Company	28	3	23	Lloyd 7	Ventura
Associated Oil Company	19	3	22	Sexton 1	Ventura
Montecito Oil Producing Co.	13	4	25	1	-------------------

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

CALIFORNIA'S MINERAL RESOURCES AND THE STATE MINING BUREAU.

By FLETCHER HAMILTON, State Mineralogist.

Mining in its broadest sense is the basic industry upon which everything, even including agriculture, depends. Relatively few of us are directly interested in the actual production of mineral substances, and as a result the general public is inclined to accept the idea that questions concerning mining are vital to miners alone. This is a grave mistake. As proof of this assertion, it is interesting to note the following extract from an editorial appearing in the Engineering and Mining Journal of New York under date of October 29, 1921:

> The railroads of the country carry material classified as products of mines amounting to over one-half of the total freight, and this is true even during this period of great depression * * *. During the quarter ending June 30, 1921, out of a total of 222,000,000 tons of freight carried, mineral products constituted 124,000,000 tons * * *. Compare these figures with the freight representing products of agriculture, which amounted to 21,000,000 tons; of animal products nearly 6,000,000; forest products nearly 20,000,000; and of manufacturing and miscellaneous, totaling nearly 42,000,000 tons. This relatively vast tonnage of mineral products goes into a multitude of industries of which it constitutes to a large degree the raw materials, or supplies the energy to turn the wheels of industry either directely or through the medium of electricity.
>
> The proper development of our mineral resources, their wise encouragement, and their sane conservation is a problem second to none in importance for our statesmen to consider.

While mining has been one of California's chief industries since the beginning, it is undoubtedly a fact that the general public has no understanding of the possibilities which still remain in this respect. Comparatively speaking, the mineral land located throughout the length and breadth of the state has hardly begun to be developed, even though the total recorded value of metals and minerals marketed since the early days has amounted to $2,500,000,000. It is a fact that each year the output of materials not heretofore produced is noted, and districts formerly considered barren from a mining standpoint are opened up.

The State of California includes a total area of 158,360 square miles. This area is divided into fifty-eight counties. Minerals of commercial value are mined in every county. In the mountainous regions of the state are found the vein-forming minerals largely. In the desert regions of southeastern California ancient lake beds afford vast supplies of salines. Underlying the interior of the central and southern portions are huge reservoirs of crude oil. Building stones and minor industrial minerals of all descriptions are distributed throughout the length and breadth of the state. California yields commercially a greater number and variety of mineral products than any other state in the Union, and probably more than any other equal area elsewhere on earth.

Fuels. Among the most important products of California are its fuels. This subdivision includes coal, natural gas, and petroleum. Deposits of peat are also known in several localities, none of which have as yet been exploited.

Coal was first mined as early as 1860, and until the development of crude oil, was a large industry. Within the last few years, owing to the increasing price of petroleum products, a renewed interest in this branch of the mineral industry has been noted. According to an estimate of the United States Geological Survey, the total workable area of coal fields in California is about five hundred square miles, and the original content of all fields is about one billion short tons. As the total coal production to the end of 1920 has been only a little more than five million tons, it is evident that the original supply remains almost intact.

Large natural gas fields of great commercial importance have been developed in Kern, Orange, Santa Barbara, Fresno and Los Angeles counties, and the annual production of this fuel is constantly increasing.

The oil production of the state for 1921 amounted to 112,599,860 barrels, valued at $203,138,225. This shows a small increase over similar constant figures which have been recorded for several years past. It is believed that this huge production will continue for many years to come and that any shortage of oil or its products will be due to increased consumption. There is, of course, a natural decrease of production from every individual well as time passes after its completion. The average daily production from Cailfornia wells decreases about two barrels per well each year. However, this decrease has been and will continue to be offset in the future by the continual drilling of new wells. According to the records of the State Mining Bureau, the total production of petroleum since its discovery in California in 1875 to the end of the year 1921 was 1,456,185,961 barrels, which amount sold for approximately $1,195,979,174.

Metals. The total value of metals produced in California during 1920 was $21,211,079. The chief of these is, and always has been gold, followed in order by copper, silver, quicksilver, lead, zinc, platinum, manganese, and iron. Deposits of ores of nickel and vanadium have also been found in the state, although as yet there has been no commercial output. Among the metals which exist here and which have been produced at intervals in the past may be mentioned antimony, cadmium, molybdenum, tin and tungsten. Gold is widely distributed throughout California, twenty-nine counties being on the producing list. Although the total output of the yellow metal has amounted to $1,735,922,923, this branch of the mining industry will play an important part for many years to come, because, aside from partly developed mines which are known to contain immense ore reserves, it is a well-known fact that thousands of square miles of possible mineral-bearing land remain practically unexplored.

Copper, which is the second in importance among the metals of the state, occurs in Shasta County; also along the foothills of the Sierra Nevadas; and in many localities throughout the Coast Range Mountains; in what is known as the Eastern Belt, lying mostly in Mono and Inyo counties; and in the Southern Belt, lying in San Bernardino, Riverside and San Diego counties.

Silver is sometimes found alone here, as in the case of the deposits near Randsburg, which are now producing at the rate of about one hundred thousand dollars a month, and it is also commonly associated to a great or less extent with all gold, copper, lead and zinc ores.

Quicksilver has for many years been one of the state's staple products, and California supplies approximately seventy-five per cent of the nation's output of this metal. Total production, according to the bureau's records from 1850 to 1920 inclusive, amounted to 2,188,984 flasks, valued at $106,841,606.

Large deposits of iron ore have long been known in several sections of the state, scattered from Shasta County in the north to Imperial County in the south. For economic reasons, this branch of the mineral industry thus far has remained almost dormant, but our iron ore reserves will undoubtedly play their part in the upbuilding of industry as a whole, at some time in the future when petroleum or maybe gold has passed its zenith and is beginning to decline.

Space will not permit of detailed mention of the possibilities connected with many other metals existing here, but it may be truthfully said that in every case their production on almost any sized scale simply depends upon the demands of the consumer.

Structural Materials. Under the heading of structural materials the Mining Bureau lists asphalt, brick, cement, chromite, granite, lime, magnesite, marble, onyx, sandstone, slate, and miscellaneous stone. As far as it is given for the present generation to foresee, California is independent regarding supplies of these substances, fifty-five counties out of the fifty-eight producing structural materials in 1921. While there is nothing sensational in the outlook for their immediate future, the demand is growing steadily, and increased output has been consistently noted during past years, depending largely on general building conditions and the extent to which highway construction and other similar work is carried on.

A vivid illustration of the *possibilities* connected with the production of minerals in this group may be briefly cited here. Chromite was one of the many 'unimportant' minerals which have been on the bureau's list since 1874. Occasionally a year would pass when no production at all would be reported. The average output for a score of years previous to 1916 was less than one thousand tons annually. After the war had been under way for a couple of years, a sudden shortage of chromite developed, due to the entire cessation of imports and due to the increased demand for this alloy metal in the manufacture of steel. As a result of this condition, a sudden search was made for chromite, and the output in California jumped from 1500 tons in 1914 to 3700 tons in 1915; 49,000 tons in 1916; 52,000 tons in 1917; and 74,000 tons in 1918. After the signing of the armistice this demand ceased as suddenly as it started, and the 1920 production dropped back to only 1770 tons.

Industrial Materials. Abnormal conditions imposed upon many branches of industry in the United States by the war caused a breakaway from many established trade customs and business habits. Especially has this been true in manufacturing lines which had been entirely or partly dependent upon foreign sources for their supply of industrial minerals. America is still a new country; most industries originated in Europe, and were transplanted here more or less recently. Many foreign raw materials have been easily and cheaply obtainable and have been considered as standard almost by inheritance. Development of similar domestic materials has therefore often been neglected, and as the home product sometimes differs slightly in appearance or texture or composition, it has often been thought of as an inferior article.

A new era has undeniably arrived, however, and during the past five years local raw materials have been used to an ever-increasing extent, as a result of the fact that nothing else was obtainable during the war period. The Pacific Coast is still far removed from many of the principal markets of the United States and the industrial world, but facilities are improving and many markets are thus expanding. The West is even yet a land of opportunity, and as its mineral resources are divulged and the possibilities of their broader development studied, the belief is strengthened that California is due to hold her supreme position indefinitely among the important states in the Union in this regard. The leading industrial minerals thus far exploited, from the standpoint of the annual value of their output, are limestone, mineral water, pyrite, pottery clay and diatomaceous earth. Others on the producing list include asbestos, barite, feldspar, fluorspar, gypsum, pumice, silica and talc. The outlook for these substances and others of similar character is particularly bright.

Salines. Salines produced in California include borax, salt, soda, potash and other alkaline compounds. The principal saline resources of the state are located in the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino and San Luis Obispo counties.

The borax output comes principally from Inyo and Los Angeles counties, although a portion of this production is made from the brine of Searles Lake in San Bernardino County. California is the sole producer of borax in the United States, and the output since 1864, according to the records of the State Mining Bureau, has amounted to 1,273,925 tons, valued in the crude state at $43,859,685.

During recent years potash-bearing minerals of all grades have been produced in California, including refined sulphate from cement dust, kelp ash, potash char from molasses distillery waste and waste water in beet sugar manufacture. The principal tonnage, however, has come from the concentrated salts in the brine of Searles Lake. As in the case of many other mineral substances, the production of this material depends upon economic conditions, and is almost unlimited so far as the supply of raw material is concerned. During the war the demand for potash was comparable with that of chromite, previously referred to. The value of the potash output in 1914 amounted to $460. Spurred on by the war demand, this increased to $19,000 in 1915; $666,000 in 1916; $4,200,000 in 1917 and $6,800,000 in 1918. These figures have temporarily declined, although the value of the 1921 output was $390,210.

Practically all of the salt produced in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of the San Francisco Bay, Monterey Bay, San Diego Bay and at Long Beach. In addition to the inexhaustible supply of this material present in the ocean waters, there are immense deposits of rock salt known to exist at various localities of the desert portion of San Bernardino County.

Summary of Future Outlook. As has already been mentioned, the production of petroleum from proved oil land should continue for many years with profit to the producers, as well as to the benefit of industries dependent upon oil, and to the state at large. It is almost an assured fact that other oil deposits in California remain to be discovered, and further prospecting under the guidance of qualified geologists should be profitable.

In regard to all other minerals, even including gold, the peak of production is not even in sight, and, while there may be fewer discoveries of bonanza ore in the future than there have been in the past, improved methods of mining and treatment of all classes of crude mineral substances will more than offset the exhaustion of the rich and superficial deposits, which made the state famous two or three generations ago.

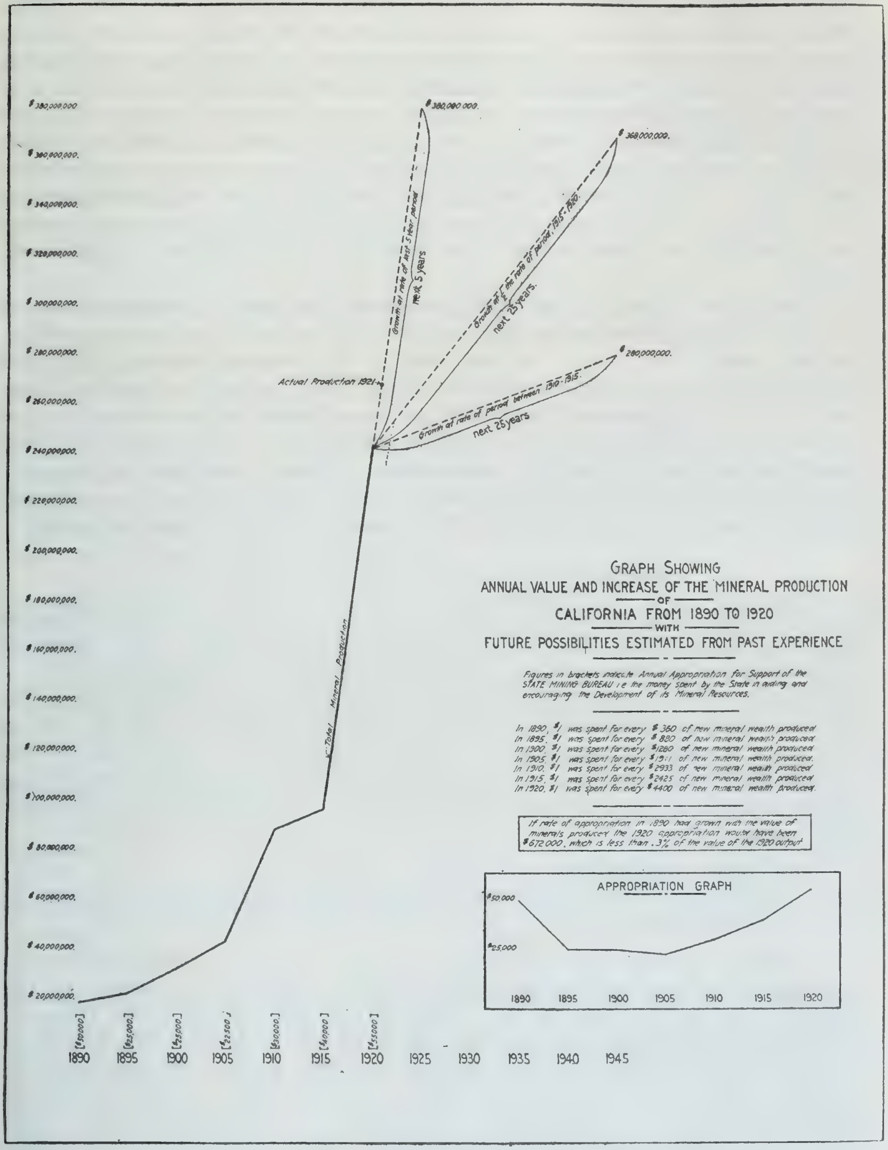
Other features are also working to assist in the upbuilding of the mineral industry as a whole. For example, the new state highway system has already proved to be of considerable aid to many mining districts, particularly in the northern portion of the state where the old roads often became impassable in wet weather, and where, as a result, operations had to be brought to a close for the winter months.

Also, electrometallurgy is gradually replacing processes of treating ores which depend upon various fuels, and as the demand for such products increases, the metallurgist could wish for no better field in which to operate than in the mountainous regions of California, where perpetual streams, offering unlimited power, and mineral deposits are so often side by side.

VALUE OF CALIFORNIA'S MINERAL PRODUCTION.

As will be noted on the accompanying chart (to which the 1921 figures have been added since it was drawn), the value of California's total mineral production has shown a remarkable growth during the past thirty years. In 1890 the figures amounted to slightly over $18,000,000. This has increased at an accelerated rate until in 1921 it had reached the unprecedented figure of $268,157,472.

It is impossible to prophesy what this amount will be in twenty-five years or five years or even one year. However, it is interesting to note the dotted lines which have been placed on the chart representing possibilities, any of which may easily come true. It will be seen that if the



GRAPH SHOWING
ANNUAL VALUE AND INCREASE OF THE MINERAL PRODUCTION
OF
CALIFORNIA FROM 1890 TO 1920
WITH
FUTURE POSSIBILITIES ESTIMATED FROM PAST EXPERIENCE

Figures in brackets indicate Annual Appropriation for Support of the STATE MINING BUREAU i.e. the money spent by the State in aiding and encouraging the Development of its Mineral Resources.

In 1890, $1 was spent for every $360 of new mineral wealth produced
In 1895, $1 was spent for every $880 of new mineral wealth produced
In 1900, $1 was spent for every $1280 of new mineral wealth produced
In 1905, $1 was spent for every $1911 of new mineral wealth produced.
In 1910, $1 was spent for every $2933 of new mineral wealth produced
In 1915, $1 was spent for every $2425 of new mineral wealth produced
In 1920, $1 was spent for every $4400 of new mineral wealth produced.

If rate of appropriation in 1890 had grown with the value of minerals produced the 1920 appropriation would have been $672,000, which is less than .3% of the value of the 1920 output rate of growth of the last five-year period should be maintained until 1925, (and there is no valid reason why this could not be the case), the yearly value of our mineral production would reach the sum of $380,000,000. If the increase is at only one-half the rate of the period from 1915 to 1920, the total figure in another twenty-five years will approximate $368,000,000. If the rate of growth on the other hand drops back to correspond with the period between 1910 and 1915, which, taken as a whole, was a time of overproduction and low prices, the mineral output for 1945 would be valued at $280,000,000 in round numbers. Even though the 1921 figure should never be exceeded and would represent the average for all future years to come, it would be of unquestioned advantage to the state to foster an industry which brings a quarter of a billion dollars worth of new wealth into existence each year. This mineral production accounts for an additional source of taxable wealth and also gives employment and a generous income to thousands of persons who are dependent upon it for their livelihood.

From data furnished by the Industrial Accident Commission, it is estimated that there were employed in the mines, dredgers, quarries, cement and brick plants, approximately 13,000 men during 1921, and approximately 25,000 men in the oil fields exclusive of refineries, making a total of approximately 38,000 men employed in the mineral industries in California last year. The production for the year of $268,157,472 worth of minerals, therefore, represents, in round numbers, an average output of $7,000 for every man employed, or an average of $8,300 per man in the oil fields and $5,000 per man in the other branches.

STATE AID TO MINING IN CALIFORNIA.

The state renders various services to the mineral industry through the medium of the California State Mining Bureau. The work of the bureau is primarily of an economic nature. The organic act under which it operates might be condensed to read "The bureau is created for the purpose of assisting in all possible ways in the development of the state's mineral resources." This sounds like a simple set of instructions; however, a brief consideration of the limiting conditions under which the bureau must function somewhat dispels that illusion. They are:

1. Funds available;
2. Area to be covered and scope of the mineral industry in California.

In regard to the first condition, it may only be remarked that the securing of an apropriation commensurate with the importance of the work in hand depends all too often on considerations other than an unbiased and intelligent understanding of the subject. Work undertaken in good faith and forwarded efficiently and vigorously may be nullified by loss of legislative support at a moment when it is only partly completed. Insufficient funds may render impossible the carrying on of broad investigative campaigns, which would result in bringing millions of dollars into the pockets of the citizens of the state. A bureau of this sort should not only be created and given a field in which to work, but it should receive a consistent allotment. By referring to the chart previously mentioned, it will be noted that the bureau's appropriation in 1920 was only a fraction more than the appropriation in 1890, and the fluctuations in the funds available during the intervening years were obviously based on no definite program. Even in 1890, $360 worth of new mineral wealth was produced in California for every dollar spent by the state in attempting to aid that production. At that same ratio, which is less than three-tenths of one per cent, the 1920 appropriation would have amounted to approximately $672,000 instead of $55,000! However, while it is true that infinitely more good could be accomplished with more money, and that the amount appropriated annually is ridiculously small compared to the amount the state derives from its mines, oil fields and quarries, the fact remains that only a minority of the people in the state are *directly* interested in mining, and therefore demands made upon the legislature have not been so popular as others which had to do with activities touching larger bodies of our citizens.

Owing to the fact that the allotted funds have been fairly constant (even though small) during the past several years, the bureau has been enabled to gradually evolve a program which, it is believed, has given the public full value received, and has accomplished, at least in some degree, its primary object.

The area to be covered and the scope of the industry in this state have been briefly touched upon in preceding paragraphs.

To assist in the development of the mineral industry, or group of industries indicated, which are scattered over an empire larger than the New England States, New York, New Jersey, Delaware and Ohio put together, the bureau has worked out a plan of action, which will be briefly described as follows:

Work of the Bureau. Bureau headquarters are located in the third floor of the Ferry Building, San Francisco. Here are the offices of the State Mineralogist, executive offices of the mining and oil departments, statistical division, library, museum containing about 18,000 mineral specimens, the laboratory for the free determination of mineral samples, and the drafting room.

The business management of the bureau and the direction of all its works are conducted at the San Francisco office. This office is also a general information bureau open to the public at all times. A large proportion of the time of the State Mineralogist and all the technical staff is taken up in answering inquiries, both written and personal, received from persons who are interested in every conceivable phase of the mineral industry, many of whom live in other states and foreign countries.

Mining Department. Branch offices of the mining department are located in Redding, Shasta County; Auburn, Placer County; and Los Angeles. Each office is in charge of a mining engineer of practical experience, and each district engineer has a definite field to cover. Including the central California district, which is handled from the San Francisco office, the state is thus divided into four distinct fields, in each of which there is a representative of the bureau readily accessible to the local mining public. This representative has his home in his district and his interests are not those of a traveling investigator, but of a citizen of the section in which he lives. He becomes personally acquainted with the miner and the prospector, a class of men who are often reticent and diffident, and after gaining their confidence, his value to them and to the bureau is greatly enhanced. Remote mines are brought into closer touch with the bureau through the medium of the district engineer. His knowledge of routes of travel and familiarity with local conditions save time and prevent lost motion, and the perspective he gains permits him to evaluate more correctly what he sees and hears. The district engineer has a working program somewhat as follows:

1. He is assigned the duty of preparing formal bulletins upon special subjects which are usually peculiar to some branch of mining in his district. The completion of a report of this kind may require months or even years. It demands exhaustive investigation and often research work.

2. Interwoven with and overlapping the work mentioned under number one comes the careful, constant survey of the field to which the engineer has been assigned. He keeps advised as regards new discoveries, development of all mining properties, and all other details of the industry as far as it is possible to do so.

3. The district engineer is the servant of his local mining public just as the State Mineralogist is the servant of all of the people of the state. This has been mentioned last, but as a matter of fact a call for any assistance that a bureau representative is authorized to render takes precedence over all else. Other work is set aside until such a call has been responded to and cared for to the best of his ability.

Statistical Department. The statistical section keeps an up-to-date list of all owners and operators of mineral deposits and mines in the state. By correspondence and personal visits production data are obtained and published annually. Not only is such information of well-recognized value, but buyers and consumers are being continually referred to producers through the medium of the bureau's records, in a direct and satisfactory manner. By means of an addressograph and other modern office equipment, the vast amount of detail work required to make a recurring statistical inquiry dependable and authentic is efficiently carried on.

Laboratory. In the laboratory free determination is made of specimens sent in from any point in the state. This service is widely used and is of particular value to the man of limited means who may have discovered minerals with which he is not familiar. Instead of being forced to pay to have a sample analyzed, which may very possibly be valueless from a commercial standpoint, he may first be advised by the bureau as to what the possibilities are in this regard.

Library. The library, which is freely available for reference to all, contains approximately five thousand books, most of which are related to mining and engineering, and it also contains a file of local newspapers from most of the mining towns of California, as well as a file of the principal technical magazines published throughout the United States.

Museum. The museum, which has gradually been built up during the past forty years, contains approximately 18,000 specimens of ores, wall rocks and minerals, mostly from California, but in part, from many other states and foreign countries. It ranks among the first five of such collections located in North America.

Situated as it is in the Ferry Building, which is a union depot and gateway to San Francisco for hundreds of thousands of persons daily, the museum attracts a great deal of attention and undoubtedly is a direct aid in developing the mineral industry of the state.

For example: When the call came for chromium and manganese in 1917 the museum was thronged with men who came to scrutinize the minerals containing those metals, so that they would be able to prospect with greater intelligence.

Drafting Room. This is purely and simply a workshop, and is the only branch of the bureau that isn't primarily at the service of the public. In the drafting room are prepared well-logs, maps, sketches, etc., for the many publications and reports which are under way at all times.

NEEDS OF THE MINERAL INDUSTRY.

The mineral industry merits stronger support than it is now receiving from the state government.

As has been pointed out, the undeveloped mineral resources of California offer almost unlimited possibilities.

The State Mining Bureau is doing everything in its power to help turn these possibilities into realities.

Wonderful opportunities to add to the state's wealth and prosperity are offering themselves, many of which cannot be taken advantage of because the funds at hand are insufficient to adequately cover the field.

As an illustration, the situation relative to "industrial minerals" may be briefly cited; similar conditions confront practically every other branch of the mining industry. Eastern manufacturing concerns are coming to California in ever increasing numbers. Some of them have built branch factories here during the past year; others are contemplating such a move, but are not yet thoroughly convinced that their requirements can be fulfilled.

Inquiries are coming to the Mining Bureau by the score from every part of the country, asking for details as to quantity available and quality of raw materials suitable for the manufacture of abrasives, acids, alloys, aluminum, asbestos products, barium compounds, bleaching powders, brick, cement, chalk, chemicals of all kinds, chinaware, clay products, concrete, enamels, ferro-alloys, filters, fertilizers, glass, graphite, insulators, iron, lime, lithium, marble, mica, molybdenum, munitions, paint, paper, pavements, plaster, pottery, pumice, refractories, roofing, sewer pipe, slate, sulphur, talcum, tiling, whiting, zinc compounds, and other products too numerous to mention, all of which are latent in California.

A study of our potential supply of industrial materials offers a most promising field for fruitful endeavor.

Competition may often be close between a California product and one situated elsewhere. Information as to transportation facilities and other economic considerations are often the pivots upon which capital and business will turn toward, or away from, a proposed project. Authentic facts are necessary to attract permanent industries.

The bureau is doing what it can to collect, correlate and publish such facts. Coming from a source known to be authoritative, they carry weight which would not be accorded the statements of a promoter or other private party with selfish interests at stake.

Under present conditions this work can only be done piecemeal, and by slow degrees.

SECRETARY'S OFFICE.

W. W. Thayer, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

This organization has been occupied for 42 years in actively and in all possible ways assisting in the development of California's mineral resources. Its work, whenever possible, is made a matter of permanent record by means of published bulletins and reports. These publications form a cumulative, live and up-to-date history of mining progress in the state. Prospective investors from other states and other lands come to the State Mining Bureau for information as to the location of mineral deposits, the extent and value of their mineral content, and names of owners with whom they may enter into business transactions. Owners and operators—producers of raw materials—who live here come to the Bureau to find out where they may be able to market their output, and to learn whether or not the mineral they have discovered is commercially valuable, and if it meets the requirements of the consumer.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of Secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

As a means of illustrating the organization of the Bureau, the accompanying chart is presented on page 630.

The Bureau headquarters are located in the third floor of the Ferry Building, San Francisco. Here are the offices of the State Mineralogist, executive offices of the mining and oil departments, statistical division, library, museum laboratory, and drafting room.

The business management of the Bureau and the direction of all its work are conducted at the San Francisco office. This office is also a general information bureau open to the public at all times. A large proportion of the time of the State Mineralogist and all the technical staff is taken up answering inquiries, both written and personal, received from people who are interested in every conceivable phase of the mineral industry, many of whom live in other states and foreign countries.

Mining Department.

Branch offices of the mining department are located in Redding, Shasta County; Auburn, Placer County, and Los Angeles. Each office is in charge of a graduate mining engineer of practical experience, and each district engineer has a definite field to cover. Including the Central California district, which is handled from the San Francisco office, the state is thus divided into four distinct fields, in each of which there is a representative of the Bureau readily accessible to the local mining public. This representative has his home in his district, and his interests are not those of a traveling investigator, but a citizen of the section in which he lives. He becomes personally acquainted with the miner and the prospector, a class of men who are often reticent and diffident, and after gaining their confidence his value to them and to the Bureau is greatly enhanced. Remote mines are brought into closer touch with the Bureau through the medium of the district engineer. His knowledge of routes of travel and familiarity with local conditions save time and prevent lost motion, and the perspective he gains permits him to evaluate more correctly what he sees and hears. The district engineer has a working program somewhat as follows:

1. He is assigned the duty of preparing formal bulletins upon special subjects which are usually peculiar to some branch of mining in his district. The completion of a report of this kind may require months or even years. It demands exhaustive investigation and often research work.

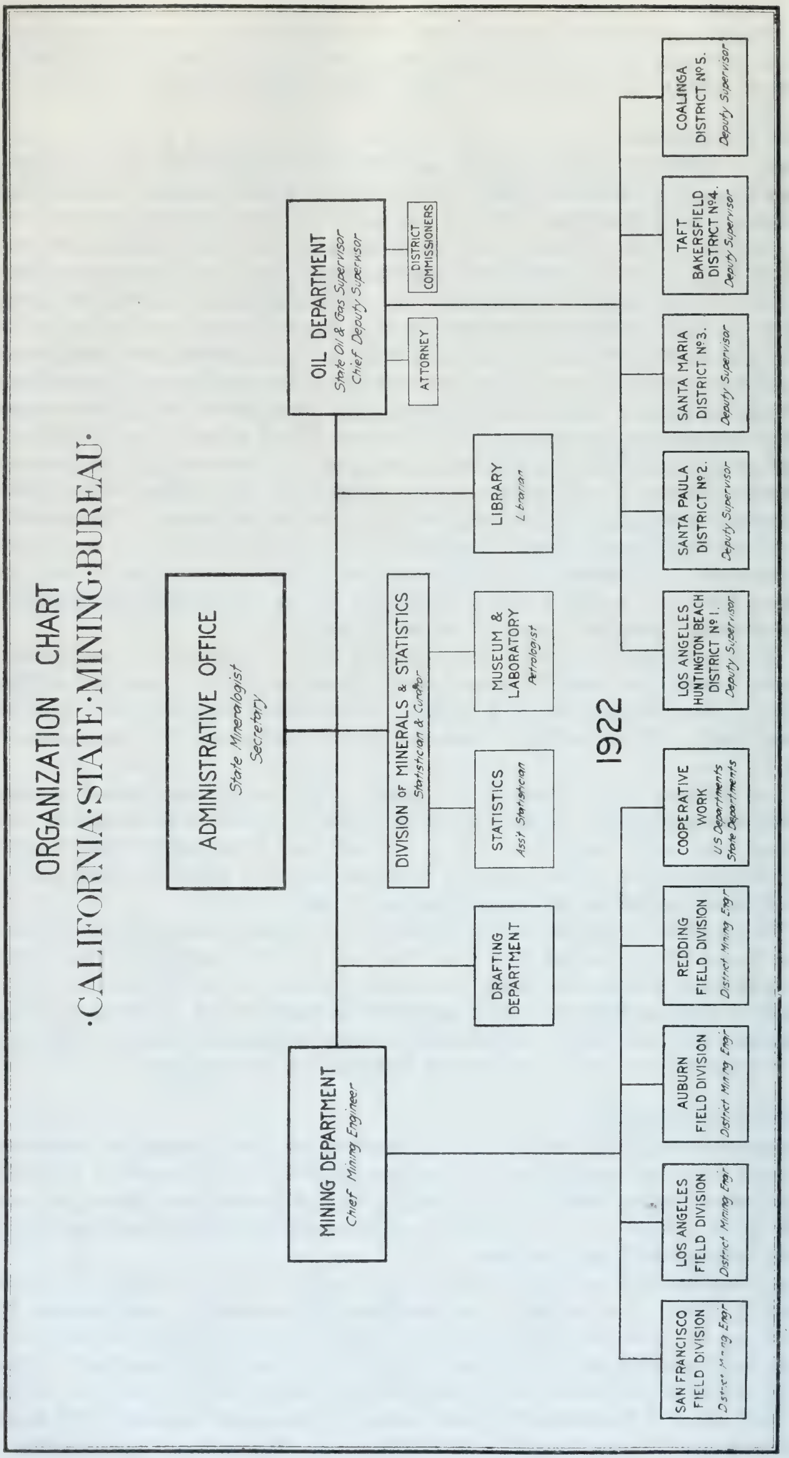
2. Interwoven with and overlapping the work mentioned under number one comes the careful constant survey of the field to which the engineer has been assigned. He keeps advised as regards new discoveries, development of all mining properties, and all other details of the industry as far as it is possible to do so.

3. The district engineer is the servant of his local mining public, just as the State Mineralogist is the servant of all the people of the state. This has been mentioned last, but as a matter of fact a call for any assistance that a Bureau representative is authorized to render takes precedence over all else. Other work is set aside until such a call has been responded to and cared for to the best of his ability.

Petroleum Department.

Conservation of the oil and gas resources of California has for over six years been provided for by state supervision. The most obvious and serious cause of waste in California oil fields has been due to waters which flood productive formations; consequently legislation has been aimed directly at that feature.

The department of petroleum and gas was established by law August 9, 1915. Under this law the State Mineralogist is authorized to appoint as oil and gas supervisor an engineer or geologist experienced in the development of petroleum. This office has supervision over the drilling, operation, maintenance and abandonment of oil and gas wells. The staff of the petroleum department is composed entirely of men technically trained as mining engineers, civil engineers or geologists.



ORGANIZATION CHART

·CALIFORNIA·STATE·MINING·BUREAU·

1922

For administrative purposes, branch offices of the petroleum department, each in charge of a deputy oil and gas supervisor, are maintained in Coalinga, Bakersfield, Taft, Santa Maria, Santa Paula, Los Angeles and Huntington Beach.

The business of the department concerning oil operations is transacted in the branch offices, between the field representatives of the companies and the deputy supervisor in charge of the district. At each field office there are models, maps, cross-sections, and all the various data used in determining the specifications to be applied to any well.

The department of petroleum and gas is supported financially by assessment levied directly upon oil land and oil and gas produced, and is independent in this regard of the varying appropriations which support the other activities of the Bureau. Up to date the amount expended has been less than one mill per barrel of oil produced. The cost of state supervision, looked at from another angle, has averaged about $40 per well, which has come under the Bureau's supervision. When it is remembered that the average cost of drilling an oil well in California is not less than $40,000, the insignificance of this tax is emphasized.

A detailed description of the operation of the oil and gas law would occupy the space of a small pamphlet, but the records are available for the inspection of any one interested, and it is confidently stated that the general plan of supervision, based upon scientific and technical methods, has unquestionably demonstrated its usefulness and will undoubtedly be retained in California.

Division of Minerals and Statistics.

The statistical section keeps an up-to-date list of all owners and operators of mineral deposits and mines in the state. By correspondence and personal visits, production data are obtained and published annually. Not only is such information of well-recognized value, but buyers and consumers are continually referred to producers through the medium of the Bureau's records, in a direct and satisfactory manner. By means of an addressograph and other modern office equipment, the vast amount of detail work required to make a recurring statistical inquiry dependable and authentic is efficiently carried on.

In the laboratory free determination is made of specimens sent in from any point in the state. This service is widely used and is of particular value to the man of limited means who may have discovered minerals with which he is not familiar. Instead of being forced to pay to have a sample analyzed, which may very possibly be valueless from a commercial standpoint, he may first be advised by the Bureau as to what the possibilities are in this regard.

The museum, which has gradually been built up during the past forty years, contains approximately 18,000 specimens of ores, wall rocks and minerals, mostly from California, but in part from many other states and foreign countries. Situated as it is in the Ferry Building, which is a union depot and gateway to San Francisco for hundreds of thousands of persons daily, the museum attracts a great deal of attention and undoubtedly is a direct aid in developing the mineral industry of the state.

For example: When the call came for chromium and manganese—in 1917—the museum was thronged with men who came to scrutinize the minerals containing those metals, so that they would be able to prospect with greater intelligence.

Library.

The library, which is freely available to all for reference, contains approximately five thousand books, most of which relate to mining and engineering, and it also contains a file of local newspapers from most of the mining towns of California, as well as a file of the principal technical magazines published throughout the United States.

New Publications.

Summary of Operations—California Oil Fields, July, 1922, Vol. 8, No. 1.
Summary of Operations—California Oil Fields, August, 1922, Vol. 8, No. 2.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number Distributed
Report XII State Mineralogist	3
Report XIV State Mineralogist	6
Report XV State Mineralogist	2
Report XVII State Mineralogist	5
Mines and Mineral Resources of Colusa, etc.	1
Mines and Mineral Resources of Del Norte, etc.	1
Mines and Mineral Resources of Fresno, etc.	2
Mines and Mineral Resources of Imperial, etc.	4
Mines and Mineral Resources of Alpine, etc.	5
Mines and Mineral Resources of El Dorado, etc.	1
Mines and Mineral Resources of Los Angeles, etc.	5
Mines and Mineral Resources of San Bernardino, etc.	5
Mines and Mineral Resources of Nevada County	5
Mines and Mineral Resources of Plumas County	5
Mines and Mineral Resources of Sierra County	1
Bulletin No. 6, California Gold Mill Practices	3
Bulletin No. 37, Gems, Jewelers' Materials, Ornamental Stones of California	8
Bulletin No. 50, Copper Resources of California (revised)	1
Bulletin No. 72, Geologic Formations of California	16
Bulletin No. 75, Mining Laws—United States and California	30
Bulletin No. 76, Manganese and Chromium in California	2
Bulletin No. 78, Quicksilver Resources of California	3
Bulletin No. 85, Platinum Resources of California	5
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	46
Bulletin No. 90, California Mineral Production for 1920, with County Maps	101
Mining in California (monthly), Vol. 18, No. 7, July, 1922	150
Mining in California (monthly), Vol. 18, No. 8, August, 1922	2750
Summary of Operations, California Oil Fields (monthly)—	
Vol. 8, No. 1, July, 1922	3000
Vol. 8, No. 2, August, 1922	3100
County Maps and Registers of Mines	5
Copper Deposit Map	1
Inyo County Geological Map	3
Minaret Map	1
Tuolumne County Mineral Map	1
Map accompanying Bulletin No. 89	46
Geological Map of California, mounted	9
Oil Field Maps	303

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file, which includes reports on some 7500 mines and mineral properties in California. Also, there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 872 letters were received and answered. They are practically all requests for information, and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting Room.

This is purely and simply a workshop, and is the only branch of the Bureau that is not primarily at the service of the public. In the drafting room well logs, maps, sketches, etc., are prepared for the many publications and reports which are under way at all times.

Changes in Personnel.

The Secretary is authorized by the State Mineralogist to announce the resignation of E. S. Boalich as Chief Mining Engineer of the California State Mining Bureau, who has accepted an appointment as Mine Valuation Engineer in the Bureau of Internal Revenue at Washington, D. C. Mr. Boalich has been on the staff of this Bureau for about six years. Through his resignation the Department has lost a valued employe; one who has always rendered loyal and efficient service.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

In the two preceding issues of this bulletin (September and October, pages 429-484 and 560-586, *ante*, respectively) are given the completed figures of the mineral production of California for the year 1921, segregated both by economic groups of substances and by counties of origin.

Herein, in the tabulations following, we present the total mineral yield of each county of the state, from the earliest available records to and including the year 1921. In a number of cases, it is known that there was production of specific minerals or metals in years previous to the earliest years shown in these tabulations; but, unfortunately, there are few detailed or accurate records showing county segregations prior to 1894 when compilation of the statistical records of the California State Mining Bureau began. For gold and silver, the published reports of the U. S. Geological Survey and the Director of the Mint give county segregations back to 1880; but, prior to that year, we have only the state total annually. In the case of quicksilver, there are authentic records for all of the important mines, from which the writer has compiled county tables for the early years.

The 'Unapportioned' column is necessitated by the fact that in many cases there is but a single operator or mine producing a given mineral in the county. As it is the bureau's policy not to reveal the individual's private business without his consent, we combine the values of such products under the county where the mineral is taken out.

ALAMEDA

Year	Brick		Chromite		Pottery clay		Coal		Manganese	
	M.	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
1890			[1]397	$534					[1]	
1891			257	344						
1892										
1893										
1894	7,500	$37,500							468	$4,962
1895	12,000	60,000							600	5,400
1896	7,000	35,000							318	3,415
1897	6.500	35,750					21,900	$50,370	504	4,080
1898	7,000	35,000					70,500	176,250	440	2,102
1899	10,000	60,000					80,703	242,109	290	3,090
1900	5,000	40,000					91,731	332,066	130	1,300
1901	9,590	67,130					87,424	262,272	423	4,365
1902	10,000	60,000					67,850	203,550	870	7,140
1903	10,300	82,400					[3]			
1904	10,500	90,000					[3]		60	900
1905	12,000	95,500								
1906	21,345	413,750			10,000	$10,000				
1907	28,770	474,350			12,610	14,299				
1908	1,800	10,800	70	595	16,370	44,822			260	4,680
1909	14,800	140,000	[3]		45,348	205,194				
1910	20,919	195,889	69	552	9,541	63,925				
1911	19,660	153,330	60	500	10,500	8,300				
1912	12,800	133,100							20	360
1913	13,977	122,937			3,000	2,700				
1914	22,668	159,205			5,000	1,000				
1915	14,841	132.765							319	3,652
1916	23,551	315,941	612	7,344	4,060	2,750			562	9,005
1917	and tile	290,033	52	960	6,502	4,524			1,211	30,250
1918		258,812	220	14,600	2,675	3,850			2,746	109,874
1919		369,778	80	1,264	5,011	12,127			[3]	
1920		664,918			3,001	3,762			[3]	
1921		365,853			6,079	7,405			[3]	
Totals		$4,899,741	[3]1,817	$26,693	139,697	$384,658	[3]420.108	$1,266,617	[3]9,221	$194,575

---

[1] There was some production of chromite, manganese and salt in Alameda County in the years previous to those here shown but the separate county figures are not available.

[2] Includes crushed rock, macadam, ballast, rubble, rip-rap, sand, gravel.

[3] See under 'Unapportioned.'

COUNTY, 1890-1921.

Pyrites		Salt		Miscellaneous stone[2], value	Miscellaneous and unapportioned		
Tons	Value	Tons	Value		Amount	Value	Substance
----------	----------	[1]	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	44,450	$125,125	$73,463	1,265 cu. ft.	$1,000	Building stone.
----------	----------	43,810	114,575	94,372	500 cu. ft.	300	Sandstone.
----------	----------	55,826	122,810	69.405	----------	----------	
----------	----------	61,353	139,830	73,300	----------	----------	
----------	----------	87,800	155,812	73,845	2,000 cu. ft.	750	Sandstone.
----------	----------	78,434	137,088	66,512	----------	----------	
----------	----------	64,718	158,674	107,551	30 tons	180	Magnesite.
4,500	$18,000	114,450	324,136	107,201	13,728 lbs. 190 tons	2,162 1,100	Copper. Magnesite.
14,323	53,301	80,000	160,000	182,295	1,500 lbs. 100 tons	52 500	Lead. Magnesite.
21,811	88,500	76,877	143,605	200,702	10,000 tons	15,000	Lime.
15,043	62,992	52,990	76,340	284,181	----------	----------	
15,503	63,958	49,100	54,200	449,029	----------	----------	
14,000	56,000	68,450	126,838	496,482	500 tons	1,750	Glass sand.
16,482	54,410	54,922	163,127	512,607	1,416 tons	14,400	Asphalt.
13,404	70,782	78,462	108,694	465,653	11,943 tons 3 tons 250 tons	143,376 48 625	Asphalt. Soapstone. Glass sand.
8,105	40,516	104,978	214,808	340,208	18,290 tons ----------	241,475 233,032	Asphalt. Unapportioned, 1900-09, inclusive.
10,938	53,170	131,868	285,217	408,591	18,290 tons 40 tons	197,783 260	Asphalt. Soapstone.
6.340	31,352	121,540	201.542	404,615	----------	----------	
7,267	29,068	126,211	212,150	420,283	----------	----------	
6,029	24,128	129,318	233,388	456,064	5,000 bbls.	5,000	Lime.
9,829	34,696	126,983	292,641	381,135	50 tons 150 tons	250 1,500	Limestone. Magnesite.
11,287	45,148	103,768	220,977	457,381	10 tons ----------	20 1,740	Limestone Asbestos, chromite, pottery clay.
16,394	65,110	111,206	263,773	403,587	----------	26,657	Limestone, magnesium chloride, magnesite.
[3]	----------	148,846	315,970	413,845	----------	83,141	Lime, limestone, magnesite, magnesium salts, potash, pyrites.
9,113	45,565	130,132	410,345	311,320	----------	19,169	Asbestos, magnesium salts, potash, limestone.
8.978	42,902	157,751	552,178	309,572	----------	16,864	Magnesium salts, manganese, potash.
10,602	55,251	145,368	574,837	620,758	----------	28,354	Magnesium salts, manganese, mineral paint, potash.
13,449	70,669	108,925	370,296	513,641	----------	25,826	Magnesium salts, manganese, mineral paint, potash.
[3]233,697	$1,005,527	2,658,536	$6,258.976	$8,697,598	----------	$1,062,314	

ALPINE COUNTY, 1880-1921.

Year	Gold	Silver	Copper		Miscellaneous and unapportioned	
			Pounds	Value	Value	Substance
1880	$17,133	$24,146	----------	----------	----------	
1881	2,000	2,100	----------	----------	----------	
1882	20,000	10,000	70,895	$13,115	----------	
1883	10,000	5.000	[1]	----------	----------	
1884	5,000	4,000	----------	----------	----------	
1885	----------	----------	----------	----------	----------	
1896	400	----------	----------	----------	----------	
1897	----------	----------	----------	----------	----------	
1901	23,568	2,860	8,377	1,319	----------	
1902	10,359	3,770	----------	----------	----------	
1903	2,701	146	----------	----------	----------	
1904	4,827	145	----------	----------	----------	
1905	575	----------	----------	----------	----------	
1909	----------	----------	----------	----------	$5,465	Unapportioned, 1900-1909
1913	537	4	----------	----------	----------	
1914	----------	----------	----------	----------	----------	
1919	----------	----------	----------	----------	100	Crushed rock.
1920	[2]	[2]	----------	----------	680 160	Miscellaneous stone. Gold and silver.
1921	----------	----------	----------	----------	925	Miscellaneous stone.
Totals	$97,100	$52,171	79,272	$14,434	$7,330	

---

[1] "Small production of cement copper" reported in 1883, but record does not show exact figures.

[2] Under 'Unapportioned.'

AMADOR

Year	Gold, value	Silver, value	Coal		Copper		Pottery clay		Lime	
			Tons	Value	Pounds	Value	Tons	Value	Barrels	Value
1880	$1,495,053	$1,953	--------	--------	--------	--------	--------	--------	--------	--------
1881	1,450,000	1,500	--------	--------	--------	--------	--------	--------	--------	--------
1882	1,500,000	--------	--------	--------	--------	--------	--------	--------	--------	--------
1883	1,590,000	--------	--------	--------	--------	--------	--------	--------	--------	--------
1884	2,000,000	2,000	--------	--------	--------	--------	--------	--------	--------	--------
1885	2,145,591	3,700	--------	--------	--------	--------	--------	--------	--------	--------
1886	1,874,062	6,136	--------	--------	--------	--------	--------	--------	--------	--------
1887	1,979,956	2,069	--------	--------	--------	--------	--------	--------	--------	--------
1888	1,750,000	3,500	--------	--------	--------	--------	--------	--------	--------	--------
1889	1,560,975	6,398	--------	--------	--------	--------	--------	--------	--------	--------
1890	1,459,952	9,357	--------	--------	--------	--------	--------	--------	--------	--------
1891	1,395,962	13,895	--------	--------	--------	--------	--------	--------	--------	--------
1892	1,210,383	8,008	--------	--------	--------	--------	--------	--------	--------	--------
1893	1,505,973	5,230	--------	--------	--------	--------	--------	--------	--------	--------
1894	1,331,916	280	15,280	$23,020	--------	--------	2,500	$3,000	--------	--------
1895	1,391,929	1,089	21,323	31,985	16,500	$1,650	9,960	10,285	--------	--------
1896	1,523,351	3,767	19,775	29,662	30,000	3,000	8,413	27,825	--------	--------
1897	1,324,472	3,477	20,000	25,000	--------	--------	3,492	9,540	--------	--------
1898	1,806,363	1,742	18,500	29,550	3,000	300	7,197	8,297	--------	--------
1899	1,544,868	6,902	18,500	23,125	--------	--------	10,700	10,900	--------	--------
1900	1,373,788	14,915	27,477	41,215	220,000	34,100	11,500	9,100	--------	--------
1901	1,823,827	7,444	25,000	30,000	52,000	8,190	10,050	7,100	--------	--------
1902	1,629,151	2,686	5,450	10,912	130,000	14,620	12,723	13,728	--------	--------
1903	1,609,744	4,336	--------	--------	10,000	900	22,000	19,460	--------	--------
1904	2,060,574	4,055	--------	--------	14,000	1,400	20,608	10,770	1,700	$1,700
1905	2,445,815	17,930	--------	--------	10,000	1,560	21,775	20,000	1,000	1,500
1906	2,260,373	14,579	--------	--------	8,648	1,669	26,789	28,119	1,000	1,200
1907	2,116,182	13,515	--------	--------	5,300	1,020	12,465	13,992	--------	--------
1908	1,876,175	13,239	--------	--------	53,940	3,440	23,322	25,369	800	960
1909	2,298,785	16,701	--------	--------	288,472	36,641	33,563	32,724	1,200	1,440
1910	2,646,246	20,916	--------	--------	151,484	14,386	39,446	49,339	1,400	1,680
1911	2,832,395	28,899	--------	--------	227,848	28,481	43,352	37,359	1,200	1,500
1912	2,796,194	32,037	--------	--------	175,608	28,975	35,100	36,856	800	1,040
1913	2,901,898	18,097	--------	--------	19,023	2,949	39,678	38,653	1.000	1,200
1914	3,082,002	17,032	5,700	10,062	5,251	694	32,223	33,114	1,540	2.008
1915	3,894,125	20,409	--------	--------	4,185	732	40,156	38,879	1,000	1,200
1916	3,660,550	18,705	[1]	--------	12,349	3,038	29,246	31,106	[1]	--------
1917	3,664,164	21,358	[1]	--------	19,352	5,283	28,970	28,625	--------	--------
1918	3,249,385	29,590	[1]	--------	[1]	--------	13,562	34,346	--------	--------
1919	2,920,492	33,254	[1]	--------	--------	--------	[1]	--------	--------	--------
1920	1,788,793	19,780	[1]	--------	--------	--------	25,719	61,808	--------	--------
1921	2,167,443	35,460	--------	--------	--------	--------	22,124	46,664	--------	--------
Totals	$86,938,907	$485,940	[1]177,005	$254,531	[1]1,458,960	$193,028	[1]586,633	$686,958	[1]12,640	$15,428

[1] See under 'Unapportioned.'

COUNTY, 1880-1921.

Marble		Brick		Miscellaneous and unapportioned		
Cu. ft.	Value	M.	Value	Amount	Value	Substance
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
25,941	$35.826	--------	--------	--------	--------	
4,864	6,566	--------	--------	--------	--------	
4,389	5,415	--------	--------	--------	--------	
3,864	6,280	--------	--------	--------	--------	
2,850	3,594	--------	--------	--------	--------	
4,582	7,925	--------	--------	--------	--------	
4,103	5,891	--------	--------	--------	$318,422	Unapportioned, 1900-1909.
2,945	4,630	600	$7,000	--------	--------	
6,300	8,016	--------	--------	--------	--------	
3,074	5,379	--------	--------	--------	--------	
4,785	6,558	--------	--------	--------	750	Glass sand.
2,703	3,950	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	1,000 tons	1,200	Limestone.
--------	--------	2,109	61,369	10 tons	1,000	Asbestos.
				1,072 lbs.	40	Lead.
				1,000 tons	1,375	Limestone.
--------	--------	1,429	28,572	2 tons	200	Asbestos.
				41 tons	332	Chromite.
--------	--------	2,000	30,000	1,000 tons	1,500	Limestone.
				10,100 tons	10,100	Quartz sand.
				11,200 cu. ft.	5,600	Sandstone.
				600 tons	6,000	Soapstone.
--------	--------	2,000	20,000	90,000 cu. ft.	45,000	Sandstone.
--------	--------	2,500	25,000	6,000 cu. ft.	3,000	Sandstone.
				700 tons	2,100	Soapstone.
--------	--------	2,000	30,000	2,500 cu. ft.	2,500	Sandstone.
				350 tons	2,420	Soapstone.
				1,960 tons	3,556	Quartz.
				877 tons	670	Glass sand.
				--------	670	Miscellaneous stone.
				--------	11,237	Other minerals.
--------	--------	2,500	50,000	16,888 tons	9,855	Glass sand.
				44 lbs.	2	Lead.
				6,250 tons	2,400	Quartz.
				3,960 cu. ft.	1,500	Sandstone.
				610 tons	2,440	Soapstone.
--------	--------	4,000	80,000	523 lbs.	25	Lead.
				13,339 tons	16,142	Silica.
				--------	1,300	Miscellaneous stone.
				--------	10,950	Other minerals.
--------	--------	[1]	--------	300 tons	3,700	Chromite
				4,341 tons	12,802	Silica.
				495 tons	2,475	Soapstone.
				--------	1,300	Miscellaneous stone.
		and	Tile	--------	77,752	Brick, coal, lime, manganese, sandstone.
--------	--------	--------	95,345	65 tons	1,420	Chromite.
				4,771 tons	20,766	Silica.
				--------	1,200	Miscellaneous stone.
				--------	13,033	Coal, lead, manganese, platinum, soapstone, zinc
--------	--------	--------	[1]	88 tons	4,400	Chromite.
				13,747 tons	61,724	Silica.
				--------	6,500	Miscellaneous stone.
				--------	66,695	Brick, coal, copper, manganese, mineral paint, platinum, soapstone.
--------	--------	--------	[1]	--------	142,523	Clay and clay products.
				8,440 tons	67,366	Silica.
				--------	9,953	Coal, manganese, platinum, sandstone, soapstone.
--------	--------	--------	[1]	6,116 tons	36,432	Silica.
				--------	680	Miscellaneous stone.
				--------	102,707	Brick, coal, mineral paint, platinum, soapstone.
--------	--------	--------	[1]	1,802 tons	20,646	Silica.
				--------	1,125	Miscellaneous stone.
				--------	97,126	Brick and platinum.
70,400	$100,030	--------	[1]$427,286	--------	$1,147,991	

Year	Diamonds, value	Gold, value	Mineral water		Platinum	
			Gallons	Value	Ounces	Value
1880		$430,501				
1881		650,000				
1882		650,000				
1883		630,000				
1884		680,000				
1885		672,569				
1886		728,160				
1887		632,902				
1888		550,000				
1889		696,628				
1890		268,977				
1891		304,765				
1892		316,999				
1893		307,351				
1894		473,673				
1895		697,261				
1896		749,316	1,900	$775		
1897		667,025	2,160	900		
1898		514,508	2,685	900		
1899		486,846	2,480	1,240		
1900		485,589	15,000	1,515		
1901		864,978	10,400	1,455		
1902		916,782	14,000	1,500		
1903		1,571,507	13,000	1,550	14	$210
1904		1,932,552	12,600	1,512	66	1,000
1905		2,607,500	15,000	1,500	110	1,770
1906		3,016,747	19,500	1,950	26	475
1907		2,786,840	21,400	2,140		
1908		3,139,398	22,450	2,450		
1909		2,987,079	25,400	1,400		
1910		2,487,791				
1911	$150	2,323,396				
1912		2,346,229				
1913	175	2,269,849	1,000	250		
1914	100	1,700,000	1,200	300	119	381
1915	300	1,545,976	5,000	850	126	3,997
1916	357	1,257,231	3,150	1,125	76	3,472
1917	125	922,271	3,500	1,450	119	9,106
1918	125	645,975	3,900	1,680	114	7,723
1919	[2]	378,297	6,532	2,388	33	5,071
1920	400	467,900	6,400	5,200	fine oz. 42	4,714
1921	331	456,760	2,900	4,100	31	2,432
Totals	[2]$2,063	$28,218,128	322,657	$38,130	876	$43,781

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] See under 'Unapportioned'.

COUNTY, 1880-1921.

Silver, value	Miscellaneous stone[1], value	Miscellaneous and unapportioned		
		Amount	Value	Substance
$1,247	----------	----------	----------	
1,000	----------	----------	----------	
----------	----------	----------	----------	
----------	----------	----------	----------	
----------	----------	----------	----------	
3,700	----------	----------	----------	
13	----------	----------	----------	
6	----------	----------	----------	
500	----------	----------	----------	
518	----------	----------	----------	
5,815	----------	----------	----------	
229	----------	----------	----------	
610	----------	----------	----------	
5,504	----------	----------	----------	
----------	----------	----------	----------	
8,936	----------	----------	----------	
5,390	----------	----------	----------	
7,885	----------	700 M.	$4,200	Brick.
9,317	----------	250 M.	1,500	Brick.
		150 tons	3,000	Mineral paint.
5,009	----------	300 M.	1,800	Brick.
		900 tons	9,900	Mineral paint.
13,082	----------	600 bbls.	600	Lime.
4,634	----------	900 M.	7,200	Brick.
		1,500 bbls.	1,500	Lime.
2,219	----------	800 M.	5,000	Brick.
		400 bbls.	750	Lime.
		1,200 M.	7,200	Brick.
358	----------	250 bbls.	250	Lime.
		190 tons.	250	Limestone.
2,302	----------	670 M.	4,020	Brick.
7,134	----------	400 M.	3,200	Brick.
10,853	----------	130 M.	1,300	Brick.
8,967	----------	----------	----------	
12,708	$7,916	----------	----------	
7,205	----------	200 M.	1,200	Brick.
	32,140	----------	107,170	Unapportioned, 1900-1909.
6,429	34,932	645 lbs.	27	Lead.
5,102	78,208	----------	----------	
5,567	51,879	----------	----------	
5,163	258,503	----------	----------	
4,000	50,895	513 lbs.	20	Lead.
		90 lbs.	4	Lead.
3,433	67,143	----------	540	Chromite.
		11 lbs.	2	Copper.
3,332	67,892	1,451 tons	13,940	Chromite.
		----------	9,576	Other minerals.
		5,746 tons	104,085	Chromite.
2,991	89,870	378 lbs.	32	Lead.
		----------	329	Copper, manganese, natural gas.
2,410	77,822	3,325 tons	134,535	Chromite.
		----------	2,765	Manganese and natural gas.
1,911	92,765	----------	1,105	Gems and natural gas.
2,253	[2]	----------	161,095	Natural gas and miscellaneous stone.
1,759	203,900	----------	548	Other minerals.
$169,491	[2]$1,113,865	----------	$588,643	

Year	Gold, value	Silver, value	Copper		Mineral paint (ochre)		Clay	
			Pounds	Value	Tons	Value	Tons	Value
1880	$320,865	$643	[1]					
1881	800,000	1,200						
1882	670,000							
1883	500,000							
1884	485,000							
1885	527,538	2,558						
1886	639,457	4,926						
1887	640,417	1,477						
1888	580,000	1,500						
1889	592,243	1,071						
1890	618,821	2,499						
1891	738,883	4,860						
1892	794.531	24,441						
1893	1,669,192	122						
1894	2,119,365	5,183	654,866	$64,951	115	$2,530		
1895	1,717,916	77	175,895	16,925				
1896	1,546,398	500	87,557	8.990				
1897	1,439,861	1,745			150	2,400		
1898	1,019,023	3.462	18,400	2,052	100	225		
1899	1,265,564	9,813	165.484	27,586				
1900	1,649,126	80,762	980,934	150,585	400	3,800		
1901	2,024,685	44,687	1,701,389	268,000	125	500		
1902	2,072,939	46,234	2,087,501	251,062	259	778		
1903	1,904,125	68,280	2,246,675	297,263	200	1,000		
1904	1,789,184	65,611	2,592,124	414,399	70	385	100	$100
1905	1,836,816	78.859	3,666,810	572,022	379	1,900	40	300
1906	1,644,234	74,099	5,082,320	956,315			50	250
1907	1,097,974	54,420	3,941,883	609,203				
1908	1,378,511	62,727	4,804,446	555,704	50	250	25	250
1909	1,440,511	71,418	5,438,908	690 632			100	500
1910	1,147,705	82 866	7,345,321	778,369			30	250
1911	1,112,315	67,032	6,190,153	773,769			50	200
1912	962,145	70,748	6,125,415	1,010,693			4,281	4,431
1913	1,175,208	61,076	5,063,187	784,794	28	190	2,000	4,500
1914	1,336,875	60,442	4,468,998	594,377			280	280
1915	1,391,134	53,298	4,031,149	705,451	[2]			
1916	1,356,120	83,643	6,099,509	1,500,479				
1917	1,471,442	87,984	7,720,861	2,107,795	[2]			
1918	871,263	84,150	6,762,882	1,670,432				
1919	1,550,574	35,876	2,049,330	381,175				
1920	1,439,745	16,701	2,112,186	388,642				
1921	1,495,758	10,232	[2]					
Totals	$50,833,463	$1,427,222	[2]91,614,183	$15,581,665	[2]1,876	$13,958	6,956	$11,061

---

[1] The Union Mine at Copperopolis was a producer as early as 1861, but there are no detailed, annual figures available for Calaveras County earlier than here shown.

[2] See under 'Unapportioned'.

COUNTY, 1880-1921.

Mineral water		Limestone		Quartz crystals, value	Miscellaneous and unapportioned		
Gallons	Value	Tons	Value		Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	$18,000	717 tons	$3,583	Pyrites.
--------	--------	--------	--------	17,500	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	3,500 bbls.	5,500	Lime.
					25 tons	375	Chromite.
--------	--------	3,087	$15,430	10,000	20 tons	300	Chromite.
--------	--------	3,994	7,635	--------	40 tons	280	Chromite.
					13.9 ozs.	250	Platinum.
--------	--------	6,872	16,955	10,000	--------	--------	
--------	--------	14,165	31,446	10,000	--------	--------	
--------	--------	4,590	11,987	--------	--------	$50,075	Unapportioned, 1900-1909.
--------	--------	6,283	16,976	--------	--------	--------	
10,000	$5,000	3,943	11,733	--------	220 lbs.	10	Lead.
7,528	3,764	--------	--------	--------	--------	--------	
11,500	5,500	2,000	1,400	--------	2,500 lbs.	25	Graphite.
					7,006 lbs.	308	Lead.
					--------	9,900	Other minerals.
15,508	6,517	--------	--------	--------	650 tons	4,550	Chromite.
					290 tons	2,618	Fuller's earth.
					30 lbs.	1	Lead.
					9 ozs.	294	Platinum.
15,343	5,752	--------	--------	--------	163 lbs.	8	Lead.
					--------	1,900	Miscellaneous stone.
					--------	4,350	Asbestos, fuller's earth, mineral paint, platinum, silica.
18,255	7,025	--------	--------	--------	1,636 tons	12,570	Chromite.
					7,238 lbs.	499	Lead.
					54 ozs.	2,453	Platinum.
					--------	2,503	Miscellaneous stone.
					--------	300	Other minerals.
16,985	7,009	--------	--------	--------	1,613 tons	34,245	Chromite.
					6,395 lbs.	550	Lead.
					20 ozs.	1,433	Platinum.
					--------	2,700	Miscellaneous stone.
					--------	3,992	Clay, fuller's earth, mineral paint, silica, zinc.
10,938	6,069	--------	--------	--------	3,830 tons	159,453	Chromite.
					10 ozs.	598	Platinum.
					--------	420	Miscellaneous stone.
					--------	2,067	Asbestos and lead.
4,384	1,034	--------	--------	--------	2,019 lbs.	107	Lead.
					8 ozs.	1,076	Platinum.
					--------	600	Miscellaneous stone.
					--------	8,116	Other minerals.
5,120	512	--------	--------	[2]	20 fine ozs.	2,002	Platinum.
					--------	2,400	Miscellaneous stone.
					--------	30,048	Quartz crystals and lead.
2,809	791	--------	--------	--------	12 fine ozs.	876	Platinum.
					--------	17,527	Miscellaneous stone.
					--------	17	Copper and lead.
118,370	$48,973	44,934	$119,062	[2]$65,500	--------	$365,374	

Year	Gold and silver, value	Quicksilver		Sandstone	
		Flasks	Value	Cubic feet	Value
1875		700	$58,905		
1876		407	17,908		
1877		466	17,382		
1878					
1879					
1880	[2]$1,908				
1881	3,500				
1882	2,575				
1883	1,000				
1884	1,530				
1885	45,000				
1886	11,617				
1887	7,461				
1888	6,000				
1889	13,626				
1890	2,810				
1891					
1892					
1893	300				
1894				20,000	$7,500
1895		1	40		
1896		58	2,054		
1897		43	1,510		
1898					
1899					
1900		275	12,359		
1901	1,800	235	10,575	88,981	80,082
1902	850	605	26,500	99,395	87,456
1903		510	21,708	146,828	312,500
1904		[3]400	16,526	100,000	290,000
1905		326	12,321	118,954	276,908
1906				88,821	101,802
1907	742	17	648	86,954	78,259
1908	584	21	900	73,284	43,971
1909	[4]	11	545	47,070	24,634
1910	[4]			112,947	56,505
1911	[5]3,118	5	230	101,029	50,027
1912				51,137	15,804
1913				34,927	15,550
1914				16,000	$7,300
1915					
1916		285	26,648	[6]	
1917					
1918					
1919					
1920					
1921					
Totals	[6]$107,421	4,365	$226,359	[6]$1,186,327	$1,448,298

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] 1880 to 1890, U. S. Mint reports.
[3] Flasks of 75 pounds since 1904; previously 76½ pounds.
[4] Included with Lassen County production.
[5] Includes Lassen County production.
[6] See under 'Unapportioned.'

COUNTY, 1875-1921.

Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value		Amount	Value	Substance
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	40 tons	$400	Salt.
50,090	$12,530	------	------	------	
31,500	1,620	------	8 tons	160	Salt.
21,000	1,050	------	21 tons	439	Salt.
5,000	1,120	------	20 tons	300	Salt.
53,500	12,350	------	20 tons	80	Salt.
92,200	20,220	------	18 tons	270	Salt.
			270 M.	2,160	Brick.
142,305	79,698	------	18 tons	396	Salt.
174,000	85,900	------	18 tons	360	Salt.
156,170	38,051	$1,250	18 tons	180	Salt.
			300 M.	1,800	Brick.
160,000	80,000	------	18 tons	225	Salt.
197,375	49,344	------	150 tons	1,700	Salt.
254,075	51,233	3,500	16 tons	240	Salt.
200,000	88,000	850	10 tons	125	Salt.
150,000	75,000	620	------	104,508	Unapportioned, 1900-1909.
150,000	75,000	16,500	------	------	
136,300	68,150	16,702	------	1,596	Unapportioned.
165,330	39,061	15,300	------	------	
132,720	32,931	------	------	------	
92,000	24,951	------	------	------	
91,480	15,003	$1,000	------	------	
[5]	------	550	------	15,605	Mineral paint, mineral water, sandstone.
[5]	------	600	------	15,721	Mineral paint and mineral water.
[5]	------	700	------	15,700	Chromite, mineral paint, mineral water.
------	------	4,900	------	2,400	Other minerals.
------	------	57,488	------	------	
------	------	80,000	------	438	Other minerals.
[5]$2,445,045	$851,212	$199,960	------	$164,803	

Year	Brick		Coal*		Lime	
	M.	Value	Tons	Value	Barrels	Value
1894			35,000	$94,000		
1895			48,635	139,655		
1896	150	$4,500	44,892	118,709		
1897			39,267	105,180		
1898	5,000	25,000	47,000	113,340		
1899			53,013	131,613		
1900			51,248	145,000		
1901			35,000	100,000		
1902	800	11,600	13,960	31,160		
1903	2,600	16,000			5,300	$4,500
1904	9,385	67,495			12,187	10,359
1905	10,979	73,948			20,244	13,925
1906	23,267	169,022				
1907	48,573	403,564			1,413	1,413
1908	55,844	335,737				
1909	41,033	268,122			14,062	15,468
1910	30,284	199,079			17,338	14,750
1911	36,463	271,575			11,872	8,645
1912	32,621	283,718			14,870	12,640
1913	30,411	212,953			150,551	127,968
1914	16,064	129,543	67	268	5,666	4,724
1915	14,915	139,862	[2]			
1916	16,672	148,730	[2]			
1917	and tile	172,653	[2]			
1918	and tile	148,831				
1919		[2]				
1920	13,608	312,398				
1921		[illegible]				
Totals		[2]$3,394,330	[2]368,082	$978,925	253,503	$214,392

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] See under 'Unapportioned.'

[3] Estimated.

*Coal mining began in the Mount Diablo section of Contra Costa County at least as early as 1861, but there are no segregated county figures available earlier than those here shown. For 1867-1882 (inc.), there are records which indicate for the Mount Diablo field a total of approximately 2,500,000 tons, valued at $14,300,000.

COUNTY, 1894-1921.

Limestone		Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value	Gallons	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	7,600	$3,700	$9,000	1,400 tons	$2,200	Pottery clay.
----------	----------	5.000	1,200	----------	----------	----------	
----------	----------	9,300	3,100	----------	----------	----------	
----------	----------	10,000	3,500	----------	----------	----------	
----------	----------	12,000	1,900	----------	----------	----------	
----------	----------	12,000	1,900	----------	----------	----------	
----------	----------	31,200	8,736	----------	31,700 lbs.	3,645	Copper.
18,000	$22,500	78,000	19,500	----------	----------	----------	
----------	----------	78,000	19,000	23,060	----------	----------	
34,800	43,500	[2]	----------	76,120	----------	----------	
----------	----------	----------	----------	75,025	----------	----------	
22,038	43,038	----------	----------	210,250	2,057 tons	21,870	Asphalt.
9,140	18,282	109,400	5,470	236,047	9,500 tons 6,000 tons	123,500 7,500	Asphalt. Pottery clay.
22,556	42,837	199,800	10,590	233,782	17,085 tons ----------	222,105 683,392	Asphalt. Unapportioned, 1900-1909.
22,912	37,064	2,500	375	235,655	----------	----------	
68,708	46,208	206,500	10,325	257,503	----------	----------	
25,879	45,291	200,000	10.000	478,162	----------	----------	
26,259	34,976	192,292	4,989	660,405	----------	921,349	Other minerals.
32,657	43,661	364,288	3,643	308,727	----------	658,755	Other minerals.
11,989	14,565	[3]350,000	4,000	397,330	----------	757,748	Asbestos, cement, coal.
[2]	----------	351,724	6,154	363,753	----------	760,423	Cement, clay, coal, limestone.
----------	----------	436,265	8,563	322,507	----------	772,934	Cement and coal.
----------	----------	30,376	3,038	324,884	100 tons ----------	300 847,198	Pottery clay. Cement and copper.
----------	----------	[2]	----------	275,309	----------	193,340 926,909	Clay and clay products. Cement and mineral water.
----------	----------	----------	----------	432,654	1,743 tons ----------	3.319 1,333,682	Pottery clay. Cement and mineral water.
----------	----------	600,300	6,099	415,127	---------- ----------	198,248 1,003,258	Clay and clay products. Other minerals.
[2]294,938	$391,922	[2]3,286,545	$135,782	$5,335,300	----------	$9,441,675	

DEL NORTE COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Platinum		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Ounces	Value		Amount	Value	Substance
1880	$215,403	$300						[2]
1881	60,000							
1882	80,000							
1883	135,000							
1884	100,000							
1885	39,390	9						
1886	76,189							
1887								
1888								
1889	21,800							
1890	900							
1891	5,586							
1892	4,102							
1893	10,352							
1894	8,000							
1895	8,250							
1896	24,150							
1897	16,710							
1898	9,057							
1899	4,450							
1900	3,483							
1901	10,612							
1902	5,450							
1903	7.183							
1904	7,399		1.5	$18				
1905	10,590		1.5	22				
1906	5,945	33						
1907	878	3						
1908	3,488	19				74,787 lbs.	$9,984	Copper.
1909	1,610	52				24,449 lbs.	13,085	Copper.
							20,000	Unapportioned, 1900-09.
1910	2,388	62				26,670 lbs.	3,395	Copper.
1911	1,743	7						
1912	3,940	10						
1913	2,498	16						
1914	2,035	9	14	643	$3,250			
1915	1,018	6			3,500			
1916	405	2	2	73	1,685		267	Chromite and copper.
1917	1,373	8	10	853	2.700	3,275 tons	97,255	Chromite.
							2,151	Other minerals.
1918	565	4	1	97	8,000	7,143 tons	360,485	Chromite.
							2,584	Other minerals.
1919	867	6			6,300		67	Other minerals.
1920					9,000		2,781	Chromite and copper.
1921	[3]	[3]	[3]		5,580		449	Gold, platinum, silver.
Totals	[3]$892,899	[3]$546	[3]30	$1,706	$40,015		$509,503	

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Gold and chromite were produced in Del Norte County earlier than the years shown, but the amounts are not separable by counties.

[3] See under 'Unapportioned.'

Year	Gold, value	Silver, value	Copper		Lime	
			Pounds	Value	Barrels	Value
1880	$389,383	$208				
1881	550,000	900				
1882	600,000					
1883	530,000					
1884	575,000	16,000				
1885	35,000					
1886	619,992	1,822				
1887	706,871	365				
1888	650,000	500				
1889	427,638	408				
1890	204,583	275				
1891	173,279	359				
1892	198,321					
1893	294,610	1,220				
1894	366,707	356			10,000	$8,000
1895	700,101	448			28,500	28,500
1896	812,289	534			4,413	4,158
1897	674,626	886			13,500	6,750
1898	501,966	4,174			3,360	3,360
1899	404,497	8,414			7,935	7,935
1900	368,541	25,129	3,125	$500	7,500	6,000
1901	292,036	5,977			11,000	11,000
1902	335,031	52	2,128	319	24,599	16,176
1903	277,304				5,600	7,000
1904	474,994				12,864	7,075
1905	384,735	2,525	160,000	24,960	9,260	6,946
1906	431,746	2,690			19,217	21,138
1907	319,177	2,301		122		16,198
1908	342,033	5,504	603	83	15,921	20,192
1909	238,284	1,299			13,828	14,591
1910	171,304	967			11,300	9,944
1911	133,967	1,010			15,086	12,309
1912	105,565	843			14,023	11,218
1913	62,688	250	693	107		
1914	133,886	654			14,000	12,082
1915	401,288	1,353	417	73	15,911	12,872
1916	361,821	1,496			[3]	
1917	24,758	85	18,982	5,182	[3]	
1918	28,352	722	22,259	5,498		
1919	30,121	279				
1920	13,379	155				
1921	34,109	301				
Totals	$14,379,992	$90,669	[3]208,207	$36,844	[3]257,817	$243,444

---

[1] In addition to the segregated figures herein given, a large tonnage of limestone is annually shipped from El Dorado County for use in cement manuacture, and whose value is included in the state total for cement.

[2] Includes crushed rock, rubble, rip-rap, sand, gravel.

[3] See under 'Unapportioned.'

COUNTY, 1880-1921.

Limestone		Slate		Miscellaneous stone[2], value	Miscellaneous and unapportioned.		
Tons	Value	Squares	Value		Amount	Value	Substance
[1]	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	1,800	$11,700	-----	-----	-----	
-----	-----	1,350	9,450	-----	-----	-----	
-----	-----	500	2,500	-----	-----	-----	
500	$250	400	2,800	-----	-----	-----	
-----	-----	400	2,800	-----	-----	-----	
-----	-----	600	4,500	-----	-----	-----	
-----	-----	3,500	26,250	-----	-----	$251,820	Unapportioned, 1900-09.
-----	-----	5,100	38,250	-----	-----	-----	
-----	-----	4,000	30,000	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	6,000	50,000	-----	10 tons	162	Asbestos.
1,050	5,775	4,000	40,000	-----	112 tons	2,625	Asbestos.
-----	-----	10,000	100,000	-----	20 tons	1,000	Asbestos.
-----	15,318	7,000	60,000	-----	-----	-----	
-----	-----	6,000	50,000	$1,600	200 M.	8,000	Paving blocks.
-----	-----	6,961	45,660	530	3,763 tons	5,645	Sand (glass).
-----	-----	1,000	8,000	2,616	1,200 tons	1,800	Sand (glass).
1,000	1,000	-----	-----	5,465	3,701 lbs.	167	Lead.
-----	-----	-----	-----	4,375	-----	-----	
-----	-----	-----	-----	4,678	-----	-----	
-----	-----	-----	-----	2,600	90 lbs.	4	Lead.
-----	-----	[3]	-----	7,500	-----	5,250	Slate and soapstone.
[3]	-----	-----	-----	12,000	5,260 tons ----- 886 tons -----	72,560 19,613 1,717 1,480	Chromite. Lime and limestone. Silica. Copper and soapstone.
[3]	-----	-----	-----	6,200	8,319 tons ----- 2,684 tons -----	167,950 104,851 4,506 70	Chromite. Lime and limestone. Silica. Other minerals.
96,673	218,120	-----	-----	20,500	11,936 tons -----	674,856 11,236	Chromite. Pyrites, silica, soapstone
41,025	112,423	-----	-----	1,700	378 tons 1,600 tons -----	6,510 13,950 1,169	Chromite. Soapstone and talc. Other minerals.
41,109	139,873	-----	-----	5,500	2,640 tons -----	18,200 9,325	Soapstone. Other minerals.
15,296	66,143	-----	-----	2,750	1,652 tons	9,453	Talc.
-----	[3]$588,902	[3]58,611	$481,910	$68,014	-----	$1,393,919	

FRESNO

Year	Gold, value	Silver, value	Copper		Petroleum		Brick		Miscellaneous stone[1], value
			Pounds	Value	Barrels	Value	M.	Value	
1880	$143,433	---------	---------	---------	---------	---------	---------	---------	---------
1881	90,000	---------	---------	---------	---------	---------	---------	---------	---------
1882	80,000	---------	---------	---------	---------	---------	---------	---------	---------
1883	100,000	---------	---------	---------	---------	---------	---------	---------	---------
1884	80,000	---------	---------	---------	---------	---------	---------	---------	---------
1885	74,500	$2,456	---------	---------	---------	---------	---------	---------	---------
1886	151,186	2,701	---------	---------	---------	---------	---------	---------	---------
1887	205,242	274	---------	---------	---------	---------	---------	---------	---------
1888	200,000	2,800	---------	---------	---------	---------	---------	---------	---------
1889	185,988	4,629	---------	---------	---------	---------	---------	---------	---------
1890	49,951	1,816	---------	---------	---------	---------	---------	---------	---------
1891	82,607	10,396	---------	---------	---------	---------	---------	---------	---------
1892	[2]112,981	[2]6	---------	---------	---------	---------	---------	---------	---------
1893	7,118	---------	---------	---------	---------	---------	---------	---------	---------
1894	8,202	---------	---------	---------	---------	---------	---------	---------	---------
1895	47,249	---------	---------	---------	---------	---------	---------	---------	---------
1896	28,235	100	---------	---------	14,119	$56,750	---------	---------	---------
1897	43,144	---------	---------	---------	70,140	70,840	---------	---------	---------
1898	27,557	---------	---------	---------	154,000	154,000	2,500	$18,000	---------
1899	18,142	---------	---------	---------	439,372	439,372	5,500	38,500	---------
1900	22,346	479	---------	---------	547,960	547,960	4,250	35,062	---------
1901	21,462	---------	1 159,672	$182,648	525,433	236,444	5,000	35,000	---------
1902	54,427	---------	3,000,000	345,000	571,233	199,931	6,000	45,000	---------
1903	21,538	111	---------	---------	2,214,160	730,673	8,000	68,000	$11,038
1904	7,809	4	2,500	319	5,114,958	1,520,847	4,800	32,400	---------
1905	40,037	9,187	1,440,000	224,640	8,890,000	2,400,300	9,000	60,000	---------
1906	8,493	83	440,000	88,000	8,402,000	1,974,470	8,000	64,000	---------
1907	2,401	26	250,000	50,000	9,050,300	3,620,120	9,230	57,350	10,500
1908	1,054	11	---------	---------	10,725,389	5,898,964	13,220	106,960	16,900
1909	17,539	8,503	876,837	111,341	15,406.619	9,243,971	7,950	49,375	28,400
1910	3,373	2,980	486,725	61,999	18,651 470	9,277,241	9,533	76,267	58,089
1911	17,441	81	---------	---------	19,499,611	9,344,085	4,500	28,500	318,911
1912	6,094	23	---------	---------	19,510,932	8,487,255	5,000	40,000	307,158
1913	2,846	15	---------	---------	18,956,965	7,927,736	5,500	44,000	416,437
1914	10,231	31	---------	---------	15,952,190	7,210,389	4,500	36,000	237,963
1915	4,151	246	65,903	11,533	14,021,025	7,641,459	4,750	33,250	193,705
1916	693	69	29,173	7,177	14,594,246	7,530,631	[3]	---------	95,830
1917	5,745	289	40,662	11,101	16,259,797	13,414,333	[3]	---------	136,719
1918	4,795	37	---------	---------	16,068,919	19,138,083	and tile	89,156	244,647
1919	5,540	67	---------	---------	16,091,037	20,805,711	[3]	---------	241,213
1920	7,793	227	---------	---------	15,375,454	22,801,798	12,517	196,756	535,587
1921	13,085	75	---------	---------	12,161,565	18,643,679	[3]	---------	486,057
Totals	$2,014,428	$47,722	7,791,472	$1,093,758	259,268,894	$179,317,042	---------	[3]$1,153,576	$3,339,154

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] To end of 1892, includes Madera County, which was created March 11, 1893.
[3] See under 'Unapportioned'.

COUNTY, 1880-1921.

Mineral water		Magnesite		Natural gas		Miscellaneous and unapportioned		
Gallons	Value	Tons	Value	M. Cu. Ft.	Value	Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	216 tons 500 tons	$700 4,000	Coal. Gypsum.
--------	--------	--------	--------	--------	--------	600 tons	4,800	Gypsum.
1,200	$400	--------	--------	--------	--------	50 tons	400	Gypsum.
1,886	350	--------	--------	--------	--------	--------	--------	
2,000	900	--------	--------	--------	--------	100 tons	600	Gypsum.
2,000	900	--------	--------	--------	--------	16 tons	320	Asphalt.
5,000	4,000	--------	--------	--------	--------	--------	268,534	Unapportioned, 1900-1909.
5,142	5,142	--------	--------	--------	--------	--------	--------	
5,000	4,500	--------	--------	--------	--------	--------	--------	
7,200	7,200	--------	--------	--------	--------	839 tons	10,068	Asphalt.
4,800	2,400	38	$120	--------	--------	579 tons	6,948	Asphalt.
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	500 tons 9,000 tons	5,500 26,000	Asphalt. Clay
--------	--------	850	8,500	--------	--------	400 tons	4,400	Asphalt.
--------	--------	1,400	22,400	--------	--------	200 tons --------	2,600 750	Asphalt. Gems.
--------	--------	220	2,195	--------	--------	--------	250	Gems.
--------	--------	2,000	20,000	200,000	$21,380	50 tons -------- 336 flasks	950 700 14,125	Chromite. Gems. Quicksilver.
--------	--------	1,135	9,080	236,100	23,610	375 flasks	15,086	Quicksilver.
--------	--------	--------	--------	250,000	15,000	148 flasks	7,259	Quicksilver.
--------	--------	--------	--------	2,894,834	253,906	1,300 tons --------	13,600 450	Chromite. Other minerals.
[3]	--------	5,829	49,082	2,346,917	163,941	9,060 tons 11,000 cu. ft. 668 lbs. --------	151,824 25,000 46 36,900	Chromite. Granite. Lead. Brick, fuller's earth, mineral water.
[3]	--------	6,077	57,422	4,097,626	347,501	6,289 tons --------	109,292 31,500	Chromite. Granite.
--------	--------	1,795	16,151	5,009,327	267,123	-------- 2,314 tons -------- 35 flasks	44,150 86,181 26,800 3,652	Asbestos, brick, mineral water, quicksilver. Chromite. Granite. Quicksilver.
--------	--------	600	5,950	5,191,287	411,356	-------- --------	34,500 140,128	Granite. Chromite and brick.
--------	--------	906	8,725	3,721,313	201,865	-------- --------	49,600 17,000	Granite Other minerals.
--------	--------	945	9,540	1,886,081	190,181	-------- -------- --------	125,276 28,610 2,000	Clay and clay products. Granite. Other minerals.
[3]34,288	$25,792	21,795	$209,165	25,833,485	$1,893,863	--------	$1,300,499	

GLENN COUNTY, 1893-1921.

Year	Amount	Value	Substance
1893 and previous	3,319 long tons	$49,700	Chromite.
1909	140,000 tons	49,000	Macadam.
1910	378,000 tons	34,020	Rubble.
1911	421,775 tons	51,430	Sand and gravel.
1912	543,675 tons	32,950	Sand and gravel.
1913	416,640 tons	27,776	Sand and gravel.
1914		30,553	Miscellaneous stone.
1915	746 lbs.	131	Copper.
		46,526	Miscellaneous stone.
		10	Other minerals.
1916		41,180	Miscellaneous stone.
		39,982	Other minerals.
1917	879 tons	21,474	Chromite.
	369 tons	9,721	Manganese.
		33,260	Miscellaneous stone.
		817	Other minerals.
1918	1,129 tons	57,263	Chromite.
		32,436	Miscellaneous stone.
1919		58,137	Miscellaneous stone.
		1,500	Other minerals.
1920		134,707	Miscellaneous stone.
1921		103,197	Miscellaneous stone.
Total value		$855,770	

IMPERIAL COUNTY, 1907[1]-1921.

Year	Brick		Gold, value	Silver, value	Miscellaneous stone, value	Miscellaneous and unapportioned		
	M.	Value				Amount	Value	Substance
1907	1,000	$10,000	----------	----------	----------	----------	----------	
1908	2,225	22,250	$5,848	$123	----------	375 lbs.	$51	Copper.
1909	2,000	20,000	59,705	524	----------	----------	----------	
1910	1,680	10,078	[2]87,341	[2]237	----------	----------	----------	
1911	1,200	7,000	[2]97,855	[2]189	----------	----------	----------	
1912	3,250	20,000	----------	----------	$10,000	----------	----------	
1913	5,500	44,000	31,700	94	12,000	750 cu. ft.	7,260	Marble.
1914	4,900	29,400	210,428	8,961	----------	13,081 lbs.	1,740	Copper.
1915	2,958	17,916	14,369	42	40,095	65 lbs.	11	Copper.
						----------	5,000	Other minerals
1916	[3]	----------	23,338	155	34,834	----------	47,006	Brick, copper, lead, pumice, strontium.
1917	and tile	19,260	919	5	65,660	1,907 tons	38,140	Manganese.
						----------	5,416	Copper, potash, pumice.
1918	and tile	11,670	247	1,248	34,787	1,241 tons	46,900	Manganese.
						----------	14,840	Copper, lead, pumice.
1919	[3]	----------	----------	8,607	63,900	----------	67,936	Brick, lead, pumice, salt.
1920	[3]	----------	----------	2,183	127,412	624 tons	16,500	Pumice.
						----------	23,787	Other minerals.
1921	654	6,363	537	920	171,173	----------	3,825	Other minerals.
Totals	----------	[3]$217,937	$532,287	$23,288	$559,861	----------	$278,412	

[1] Imperial County was created August, 1907, from a part of San Diego County.

[2] Includes production of San Diego County.

[3] See under 'Unapportioned'.

Year	Gold, value	Silver, value	Mineral water		Brick	
			Gallons	Value	M.	Value
1880	$153,940	$80				
1881	75,000	300				
1882	100,000					
1883	80,000					
1884	115,000					
1885	29,730					
1886	83,591					
1887	111,532					
1888	100,000					
1889	143,701	274				
1890	93,612	82				
1891	99,329	19				
1892	87,515					
1893	66,354					
1894	41,326	14	20,000	$7,200		
1895	92,635		24,000	12,000		
1896	65,093		15,000	10,000		
1897	94,992	57	10,000	2,000		
1898	57,512				300	$2,500
1899	65,059		6,000	1,500	410	3,870
1900	109,444	[1]136	6,000	2,000	795	7,100
1901	98,487	[1]59	7,825	2,000	1,005	7,810
1902	60,015		10,000	2,500	2,170	17,040
1903	38,509				1,060	10,445
1904	62,061				2,565	21,350
1905	45,824				800	7,600
1906	48,295	240			915	8,690
1907	40,109	214			140	1,400
1908	33,066	325			760	8,585
1909	25,690	94			1,310	9,750
1910	35,289	150			476	4,048
1911	34,966	169			357	2,880
1912	31,271	150			772	6,415
1913	25,611	132			500	4,150
1914	18,686	57			607	6,120
1915	15,947	62	2,000	500	463	5,565
1916	21,279	55	3,000	750	[2]	
1917	23,086	95	[2]		[2]	
1918	8,028	72	[2]		[2]	
1919	16,260	134	[2]		[2]	
1920	2,538	19			[2]	
1921	2,054	37				
Totals	$2,552,436	$3,026	[2]$103,825	$40,450	[2]15,405	$135,318

[1] Recalculated to 'commercial' from 'coining value' as originally published.
[2] See under 'Unapportioned'.
[3] Includes crushed rock, rubble, rip-rap, sand, gravel.

COUNTY, 1880-1921.

Miscel-laneous stone[3], value	Natural gas		Miscellaneous and unapportioned		
	M. Cu. Ft.	Value	Amount	Value	Substance
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
$199,240	------------	------------	------------	------------	
251,586	------------	------------	------------	------------	------------
233,454	------------	------------	------------	------------	
193,502	------------	------------	------------	------------	
297,276	------------	------------	------------	------------	
160,845	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	$362	Platinum.
------------	------------	------------	------------	140	Platinum.
------------	------------	------------	12.5 ozs.	204	Platinum.
------------	------------	------------	30.8 ozs.	555	Platinum.
------------	------------	------------	------------	------------	
13,074	------------	------------	1,280 cu. ft.	1,280	Granite.
29,170	600	$300	2,450 tons	7,640	Clay.
			------------	20,985	Unapportioned, 1900-1909.
36,700	1,000	500	250 tons	750	Clay.
37,756	300	150	937 tons	937	Clay.
229,730	300	150	396 tons	400	Clay.
439,808	300	150	7,750 lbs.	1,201	Copper.
208,204	300	150	3 ozs.	115	Platinum.
335,292	[2]	------------	------------	1,320	Copper and natural gas.
60,260	[2]	------------	7 ozs.	296	Platinum.
			------------	192,255	Brick, clay, granite, natural gas.
			6 ozs.	351	Platinum.
27,014	[2]	------------	------------	9,312	Brick, clay, mineral water, natural ga volca
			370 tons	21,744	Chromite.
			210 tons	420	Clay.
51,082	640	85	------------	116	Granite.
			1,520 tons	57,751	Manganese.
			2 ozs.	140	Platinum.
			------------	2,516	Brick, mineral water, pumice.
25,198	[2]	------------	------------	9,271	Brick and clay.
			------------	1,148	Mineral water and natural gas.
			859 tons	18,513	Manganese.
133,290	[2]	------------	------------	5,436	Brick, clay, granite, mineral water, natural gas, volcanic ash.
131,688	[2]	------------	75 tons	190	Pottery clay.
			------------	4,628	Brick, mineral water, natural gas, platinum, pumice.
$3,094,169	[2]3,440	$1,485	------------	$359,861	

INYO COUNTY,

Year	Gold, value	Silver, value	Lead		Copper		Zinc		Borax, value
			Pounds	Value	Pounds	Value	Pounds	Value	
1880	$48,648	$173,916	--------	--------	--------	--------	--------	--------	--------
1881	170,000	140,000	--------	--------	--------	--------	--------	--------	--------
1882	220,000	130,000	--------	--------	--------	--------	--------	--------	--------
1883	90,000	38,000	--------	--------	--------	--------	--------	--------	--------
1884	80,000	82,000	--------	--------	--------	--------	--------	--------	--------
1885	24,998	73,461	--------	--------	--------	--------	--------	--------	--------
1886	20 156	101,670	--------	--------	--------	--------	--------	--------	--------
1887	10,649	103,370	--------	--------	--------	--------	--------	--------	--------
1888	25,000	75,000	--------	--------	--------	--------	--------	--------	--------
1889	193,957	30,706	--------	--------	--------	--------	--------	--------	--------
1890	62,432	88,320	--------	--------	--------	--------	--------	--------	--------
1891	35,466	112,730	--------	--------	--------	--------	--------	--------	--------
1892	13,930	35,995	--------	--------	--------	--------	--------	--------	--------
1893	25,945	52,475	--------	--------	--------	--------	--------	--------	--------
1894	52,639	83,640	900,000	$27,000	--------	--------	--------	--------	$81,298
1895	92,142	188,329	1,498,000	46,438	--------	--------	--------	--------	40,000
1896	238.507	108,619	1,220 000	36,600	--------	--------	--------	--------	24,900
1897	159,840	50,063	564.000	19,176	--------	--------	--------	--------	--------
1898	137,107	73,503	580,000	21,170	49,829	$3,986	--------	--------	33,000
1899	114,187	57,529	662,000	28,135	--------	--------	--------	--------	24.000
1900	213,655	113,483	971,000	38,840	--------	--------	--------	--------	13,901
1901	162,406	56,573	601,000	24,040	8,566	1,349	--------	--------	24,250
1902	74,397	14,484	257,500	9,013	1,100	126	--------	--------	36,394
1903	66,045	18,200	95,000	3.420	23,450	3,098	--------	--------	26,400
1904	150,474	7,122	124,000	5,270	25,508	3.252	--------	--------	--------
1905	135,959	29,741	345,680	16,247	151,606	23.649	--------	--------	--------
1906	19,449	13,358	208,018	11,857	4.145	800	--------	--------	--------
1907	57,241	44,440	261,140	13.096	6,779	1,356	144,213	$8.598	*
1908	308,873	30,900	683,401	28,244	6,820	938	--------	--------	*
1909	457,486	47,117	2,364,137	131,199	39,888	5,073	--------	--------	*
1910	408,509	129,590	2,866,227	127,385	58,801	7,489	--------	--------	*
1911	574,945	45,678	1,182,122	53,195	27,889	3,486	*	--------	*
1912	369,758	45,316	1,207,593	54,342	48,584	8,016	*	--------	*
1913	237,310	136,854	3,322,308	146,182	113,860	17,648	*7,149,523	449,701	*
1914	275,000	255,000	4,626,934	180,450	336,423	44,744	399,641	20,381	*
1915	317,905	127,894	4,323,639	203,211	154,722	27.076	4,625,162	573,520	*8,162,727
1916	131,722	232,441	11,185,321	771,787	274,032	67,412	5,758,703	771,666	[1]
1917	125,394	534,599	19,318,642	1,661,403	175,273	47,850	3,525,000	359,550	[1]
1918	100,240	441,548	12,223,471	867,866	338,518	83,614	2,517,045	229,051	[1]
1919	69,560	194,151	3,643,485	193,015	169,713	31,567	1,192,353	87,042	[1]
1920	55,634	258,929	4,612,338	368,987	144,286	26,549	[1]	--------	[1]
1921	80,373	86,020	1,052,253	47,351	45,725	5,898	--------	--------	[1]
Totals	$6,208,298	$4,662,774	80,899,209	$5,134,919	2,205,517	$414,976	[1]25,311,640	$2,499,509	[1]$8,466.870

*Combined to conceal individual annual output.

[1] See under 'Unapportioned'.

1880-1921.

Soda		Soapstone and Talc		Marble		Miscellaneous and unapportioned		
Tons	Value	Tons	Value	Cu. ft.	Value	Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	--------	
1,530	$20,000	--------	--------	12,500	$62,500	--------	--------	
1,900	47,500	--------	--------	10,000	50,000	--------	--------	
3,000	65,000	--------	--------	3,000	24,000	--------	--------	
5,000	110,000	--------	--------	--------	--------	--------	--------	
7,000	154,000	--------	--------	4,000	12,000	--------	--------	
10,000	250,000	--------	--------	--------	--------	--------	--------	
1,000	50,000	--------	--------	--------	--------	20 tons	$700	Antimony.
8,000	400,000	--------	--------	--------	--------	--------	--------	
7,000	50,000	--------	--------	--------	--------	--------	--------	
*	*	--------	--------	20,000	20,000	300 tons	2,400	Salt.
*	*	--------	--------	3,000	3,000	400 tons	800	Salt.
*	*	--------	--------	17,000	17,000	--------	--------	
*	*	--------	--------	1,200	4,800	--------	--------	
*	*	--------	--------	1,000	4,000	--------	--------	
*	*	--------	--------	--------	--------	--------	--------	
*	*	--------	--------	--------	--------	--------	1,417,217	Unapportioned, 1900-1909.
*	*	--------	--------	--------	--------	45,000 tons	31,500	Rubble.
*	*	--------	--------	--------	--------	46,450 tons	32,555	Rubble.
						--------	174	Gems.
*	*	1,050	$5,250	--------	--------	--------	648	Rubble.
*	*	1,000	4,400	3,200	11,500	--------	835	Rubble.
						13,500 tons	54,000	Salt.
*	*	390	2,060	3,500	10,500	13,500 tons	54,000	Salt.
112,937	*496,250	1,513	14,000	--------	--------	--------	80,430	Antimony, dolomite, marble, pumice, salt.
						3,596 tons	14,700	Dolomite.
10,593	264,825	685	4,606	[1]	--------	--------	23,040	Miscellaneous stone.
						--------	2,317,897	Antimony, borax, gypsum, marble. molybdenum, salt, tungsten.
						11,315 tons	22,630	Dolomite.
						--------	3,000	Miscellaneous stone.
19,604	861,160	4,736	41,044	--------	--------	--------	2,639,600	Asbestos, barytes, borax, gypsum, marble, molybdenum, salt, tungsten.
						14,390 tons	32,056	Dolomite.
[1]	--------	9,635	72,549	--------	--------	--------	5,000	Miscellaneous stone.
						589 tons	854,025	Tungsten concentrates.
						--------	2,491,727	Borax, limestone, salt, soda.
						2,360 tons	12,000	Limestone.
[1]	--------	[1]	--------	--------	--------	--------	7,850	Miscellaneous stone.
						--------	2,097,271	Borax, dolomite, marble, pumice, salt, soda, talc, tungsten.
						15,240 tons	31,080	Limestone.
						--------	1,190	Miscellaneous stone.
23,132	933,023	[1]	--------	[1]	--------	--------	2,214,008	Borax, dolomite, fuller's earth, marble, volcanic ash, salt, talc, zinc.
						22,112 tons	49,073	Dolomite.
						1,185 tons	8,295	Fuller's earth.
[1]	--------	4,350	77,250	--------	--------	--------	16,250	Miscellaneous stone.
						--------	1,089,708	Borax, building stone, marble, pumice, soda.
[1]210,716	$3,701,758	[1]23,359	$221,159	[1]78,400	$219,300	--------	$15,625,659	

KINGS COUNTY, 1894[1]-1921.

Year	Brick		Gypsum		Natural gas		Quicksilver		Miscellaneous and unapportioned		
	M.	Value	Tons	Value	M. Cu. ft.	Value	Flasks	Value	Amount	Value	Substance
1894	------	------	------	------	------	------	------	------	------	------	
1895	------	------	------	------	------	------	------	------	------	------	
1896	------	------	------	------	------	------	------	------	------	------	
1897	------	------	------	------	------	------	------	------	------	------	
1898	1,250	$8,450	------	------	------	------	------	------	------	------	
1899	1,650	11,550	------	------	------	------	------	------	------	------	
1900	750	5 000	------	------	------	------	------	------	------	------	
1901	1,000	5,000	------	------	------	------	------	------	------	$10,500	Unapportioned, 1900-1909.
1902	3,500	19,000	------	------	------	------	------	------	------	------	
1903	3,400	24,200	------	------	------	------	------	------	------	------	
1904	3,100	23,300	------	------	------	------	------	------	------	------	
1905	3,400	24,000	------	------	------	------	*250	$9,000	------	------	
1906	2,800	20,000	------	------	------	------	------	------	------	------	
1907	1,000	8,000	------	------	------	------	------	------	100 tons	1,000	Fuller's earth.
1908	3,000	24,000	100	$400	------	------	------	------	50 tons	1,000	Fuller's earth.
1909	1,000	8,500	100	300	360	$360	------	------	100 tons 20 tons	2,000 100	Fuller's earth. Mineral paint.
1910	400	3,200	100	490	1,200	600	100	4,525	100 tons 10 tons	1,000 270	Fuller's earth. Mineral paint.
1911	------	------	20	100	1,800	800	------	------	------	------	
1912	------	------	50	200	6,000	1,650	------	------	------	------	
1913	------	------	100	300	1,916	575	------	------	20 tons ------	60 400	Mineral paint. Other minerals.
1914	------	------	20	80	150	500	------	------	20 tons	160	Fuller's earth.
1915	------	------	------	------	258	608	[2]	------	------	18,000	Fuller's earth quicksilver.
1916	------	------	------	------	258	608	[2]	------	------	26,180	Other minerals.
1917	------	------	------	------	3,569	2,777	------	------	------	------	
1918	------	------	------	------	2,460	590	[2]	------	------	8,639	Other minerals.
1919	------	------	------	------	2,550	1,630	[2]	------	------	49,653	Other minerals.
1920	------	------	------	------	2,765	1,250	436	28,620	------	------	
1921	------	------	------	------	2,090	980	[2]	------	------	4,742	Other minerals.
Totals	26,250	$184,200	490	$1,870	25,376	$12,928	[2]786	$42,145	------	$123,704	

*Flasks of 75 pounds.

[1] Kings County was created March 22, 1893, from a part of Tulare County, and in 1909 extended by annexing a portion of Fresno County.

[2] See under 'Unapportioned.'

PHYSICAL SCIENCES LIBRARY

KERN COUNTY, 1880-1921.

Year	Asphaltum		Brick		Copper		Fuller's earth		Gold, value	Lime		Limestone		Silver, value	Natural gas		Petroleum		Miscellaneous and unapportioned		
	Tons	Value	M.	Value	Pounds	Value	Tons	Value		Barrels	Value	Tons	Value		M. Cu. Ft.	Value	Barrels	Value	Amount	Value	Substance
1880	-----	-----	-----	-----	-----	-----	-----	-----	$94,214	-----	-----	-----	-----	$390	-----	-----	-----	-----	-----	-----	
1881	-----	-----	-----	-----	-----	-----	-----	-----	190,000	-----	-----	-----	-----	14,000	-----	-----	-----	-----	-----	-----	
1882	-----	-----	-----	-----	-----	-----	-----	-----	260,000	-----	-----	-----	-----	20,000	-----	-----	-----	-----	-----	-----	
1883	-----	-----	-----	-----	-----	-----	-----	-----	150,000	-----	-----	-----	-----	5,000	-----	-----	-----	-----	-----	-----	
1884	-----	-----	-----	-----	-----	-----	-----	-----	100,000	-----	-----	-----	-----	5,000	-----	-----	-----	-----	-----	-----	
1885	-----	-----	-----	-----	-----	-----	-----	-----	72,003	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1886	-----	-----	-----	-----	-----	-----	-----	-----	94,640	-----	-----	-----	-----	1,721	-----	-----	-----	-----	-----	-----	
1887	-----	-----	-----	-----	-----	-----	-----	-----	72,358	-----	-----	-----	-----	150	-----	-----	-----	-----	-----	-----	
1888	-----	-----	-----	-----	-----	-----	-----	-----	60,000	-----	-----	-----	-----	2,500	-----	-----	-----	-----	-----	-----	
1889	-----	-----	-----	-----	-----	-----	-----	-----	242,676	-----	-----	-----	-----	7,517	-----	-----	-----	-----	-----	-----	
1890	-----	-----	-----	-----	-----	-----	-----	-----	117,341	-----	-----	-----	-----	586	-----	-----	-----	-----	-----	-----	
1891	-----	-----	-----	-----	-----	-----	-----	-----	107,735	-----	-----	-----	-----	61	-----	-----	-----	-----	-----	-----	
1892	-----	-----	-----	-----	-----	-----	-----	-----	107,738	-----	-----	-----	-----	73	-----	-----	-----	-----	-----	-----	
1893	-----	-----	-----	-----	-----	-----	-----	-----	83,665	-----	-----	-----	-----	1,754	-----	-----	-----	-----	-----	-----	
1894	6,900	$128,000	-----	-----	-----	-----	-----	-----	310,707	33,000	$26,500	-----	-----	39,700	-----	-----	11,215	$69,334	92 tons	$3,720	Antimony.
1895	1,400	28,000	-----	-----	-----	-----	-----	-----	231,433	25,400	24,980	-----	$10,000	46,064	-----	-----	116	116	33 tons	1,485	Antimony.
1896	2,484	44,680	-----	-----	-----	-----	-----	-----	590,867	37,100	32,329	5,000	5,000	34,650	-----	-----	235	235	15 tons	2,250	Antimony.
1897	4,650	86,350	1,100	$6,600	-----	-----	-----	-----	754,313	53,400	70,370	-----	-----	10,471	-----	-----	-----	-----	25 tons	3,500	Antimony.
1898	1,850	50,000	2,000	14,000	-----	-----	-----	-----	1,017,930	42,000	29,900	-----	-----	6,543	-----	-----	10,000	10,000	220 tons	1,100	Coal.
																			40 tons	1,200	Antimony.
																			27 tons	3,382	Borax.
1899	2,537	57,670	1,600	11,400	-----	-----	620	$12,400	863,414	64,700	57,690	-----	-----	6,810	-----	-----	15,000	13,500	-----	-----	
1900	701	14,020	2,525	17,300	4,000	$750	500	3,750	805,252	57,721	51,700	-----	-----	147,736	-----	-----	919,275	827,348	-----	859,927	Unapportioned, 1900-1909.
1901	3,112	43,126	4,600	23,400	429,248	67,606	1,000	19,500	1,007,059	62,000	82,700	-----	-----	40,497	-----	-----	3,902,125	1,131,616	1,600 lbs.	64	Lead.
																			50 tons	8,350	Antimony.
1902	10,150	101,500	3,500	24,500	235,840	27,122	987	19,246	1,165,982	99,360	80,856	-----	-----	99,135	-----	-----	9,777,948	1,955,585	1,000 tons	8,000	Gypsum
1903	8,006	100,787	9,000	30,000	4,300	559	250	4,750	1,022,353	101,661	76,246	-----	-----	114,614	-----	-----	18,001,148	3,600,230	28 tons	63	Bituminous rock.
																			1,000 tons	8,000	Gypsum.
1904	12,451	124,110	700	4,900	-----	-----	500	9,500	1,426,523	178,038	172,000	-----	-----	151,189	-----	-----	19,608,045	3,431,408	-----	-----	
1905	10,586	105,860	750	6,000	-----	-----	-----	-----	1,160,971	279,650	255,500	-----	44,000	134,944	-----	-----	17,069,715	3,174,966	53 tons	54	Clay.
																			1,350 tons	11,000	Gypsum.
																			52 tons	18,800	Tungsten.
1906	23,136	231,360	4,275	34,200	-----	-----	-----	-----	806,117	295,613	267,096	-----	-----	129,503	-----	-----	13,826,000	3,765,200	215 tons	752	Clay.
																			-----	183,600	Tungsten.
1907	20,443	260,158	2,168	18,428	-----	-----	-----	-----	878,798	175,000	169,822	-----	-----	86,033	-----	-----	15,700,308	4,673,867	1,000 tons	5,500	Gypsum.
1908	50,000	475,000	2,080	19,552	-----	-----	-----	-----	827,087	116,717	87,788	-----	-----	96,550	-----	-----	18,777,871	9,388,935	500 tons	2,000	Gypsum.
1909	54,599	655,391	3,365	29,634	-----	-----	359	5,385	654,799	115,709	88,869	-----	-----	101,633	38,000	$2,714	24,549,758	12,565,246	-----	500	Gems.
																			1,700 tons	8,300	Gypsum.
																			4,781 lbs.	174	Lead.
1910	76,605	811,846	8,332	63,711	-----	-----	-----	-----	619,974	99,187	86,198	-----	4,331	35,041	975,724	47,364	40,641,159	17,825,212	1,675 tons	8,305	Gypsum.
																			160,000 tons	112,000	Rubble.
1911	-----	-----	5,603	41,426	29,441	3,680	-----	-----	557,471	96,500	82,025	600	400	5,833	1,654,380	165,438	46,562,825	20,207,906	242 tons	121	Clay.
																			230,950 tons	107,880	Crushed rock.
																			853 tons	4,245	Gypsum.
1912	-----	-----	1,890	23,120	-----	-----	-----	-----	830,421	162,831	124,894	-----	-----	11,480	4,400,000	325,484	51,448,067	21,762,532	2,417 lbs.	109	Lead.
																			8,479 tons	18,188	Gypsum.
																			19,664 lbs.	885	Lead.
1913	-----	-----	1,625	22,000	3,498	542	-----	-----	649,712	135,000	91,200	-----	-----	11,851	7,111,237	568,899	58,698,432	27,038,474	208 tons	104	Clay.
																			10,000 tons	22,750	Gypsum.
																			1,376 lbs.	61	Lead.
																			-----	600	Other minerals.
1914	-----	-----	3,834	29,214	7,394	983	-----	-----	594,337	81,600	65,100	-----	-----	8,002	6,508,868	390,532	65,332,633	26,721,046	346 tons	172	Clay.
																			82 tons	320	Gypsum.
																			379 lbs.	15	Lead.
																			20,000 tons	50,000	Salt.
																			-----	180,575	Other minerals.
1915	-----	-----	-----	-----	1,047	183		-----	983,319	55,176	39,523	1,425	1,710	13,316	12,163,461	737,638	54,810,669	23,184,913	267 tons	11,301	Antimony ore.
																			84,371 lbs	3,965	Lead.
																			-----	59,319	Miscellaneous stone.
																			-----	299,997	Cement, pottery clay, fuller's earth, gypsum, magnesite, salt, tungsten.
1916	-----	-----	3,177	23,824	24,754	6,089	[1]	-----	747,042	[1]	-----		-----	8,745	16,679,658	1,379,033	54,120,509	34,691,246	145 tons	5,880	Antimony ore.
																			24,274 lbs.	1,675	Lead.
																			-----	30,047	Lime and limestone.
																			4,100 tons	23,700	Silica.
																			-----	63,723	Miscellaneous stone.
																			193 tons	482,387	Tungsten concentrates.
																			-----	363,516	Cement, clay, feldspar, fuller's earth, magnesite, quicksilver, salt.
1917	-----	-----	and tile	22,785	251,225	68,584	-----	-----	537,852	[1]	-----	[1]	-----	7,813	25,819,376	1,445,880	53,065,066	47,387,104	113 tons	16,041	Antimony ore.
																			9,684 lbs.	833	Lead.
																			300 flasks	27,250	Quicksilver.
																			-----	31,787	Miscellaneous stone.
																			49 tons	58,148	Tungsten concentrates.
																			-----	139,345	Clay, feldspar, lime, limestone, magnesite, salt.
1918	-----	-----	1,678	16,380	95,580	23,608	-----	-----	246,127	23,615	23,615	[1]	-----	7,817	23,545,128	1,507,912	49,049,917	61,410,496	-----	311	Miscellaneous stone.
																			-----	174,419	Lead, limestone, magnesite, manganese, quicksilver, salt, tungsten.
1919	-----	-----	1,709	175,112	-----	-----	[1]	-----	150,589	86,952	112,724	[1]	-----	8,402	25,363,739	1,618,913	47,734,035	64,440,947	17,000 tons	81,000	Salt.
																			-----	28,320	Miscellaneous stone.
																			-----	9,345	Fuller's earth, limestone, quicksilver.
1920	-----	-----	3,850	56,550	206	38	-----	-----	61,187	76,395	106,733	-----	-----	8,385	34,912,865	1,810,147	50,660,438	86,831,991	22,000 tons	87,000	Salt.
																			3,060 tons	20,100	Silica.
																			-----	31,180	Miscellaneous stone.
																			-----	108,270	Cement, gems, lead, quicksilver.
1921	-----	-----	5,840	85,820	-----	-----	-----	-----	84,698	72,629	141,491	-----	-----	1,897	40,136,930	1,926,797	57,434,945	97,639,407	18,500 tons	95,500	Salt.
																			-----	38,208	Miscellaneous stone.
																			-----	829,115	Cement, gypsum, limestone, silica.
Totals	286,610	$3,327,858	75,201	$699,856	1,086,533	$199,744	[1]4,216	$74,531	$21,338,704	[1]2,626,954	$2,447,849	-----	$65,441	$1,433,406	199,309,366	$11,926,751	771,727,454	$573,748,860	-----	$4,757,733	

---

[1] See under 'Unapportioned.'

PHYSICAL SCIENCES LIBRARY

(

-

1
1
1
1
1
1
1
1

1
1
1
1
1
1
1
1

1

1
1
1

1
1

1
1
1
1
1
1

—

F

LAKE COUNTY, 1873-1921.

Year	Quicksilver		Mineral water		Chromite		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	Flasks	Value	Gallons	Value	Tons	Value		Amount	Value	Substance
1873	880	$70,790								
1874	1,695	178,280								
1875	8,821	743,287								
1876	14,199	624,756								
1877	18,100	675,130								
1878	14,428	474,681								
1879	15,582	309,303								
1880	17,148	531,588								
1881	17,393	518,833								
1882	10,193	287,748								
1883	6,481	186,329								
1884	4.182	127,551								
1885	4,765	146,524								
1886	3,498	124,179								
1887	4,307	182,509								
1888	6,636	282,030	*	*						
1889	4,713	212,085	*	*						
1890	4,232	222,180	*	*						
1891	4,975	225,119	*	*						
1892	11,140	453,509	*	*						
1893	9,731	357,614	*	*						
1894	12,471	382,954	*	*						
1895	12,856	465,074	87,500	$42,000						
1896	6,307	232,484	65,920	32,460						
1897	3,585	134,546	511,950	76,585						
1898	1,729	64,746	523,000	37,350						
1899	2,954	128,179	166,020	75,924						
1900	3,165	127,345	758,600	45,400						
1901	4,395	211,324	201,706	120,360						
1902	3,611	161,568	241,100	126,663						
1903	2,595	106,397	381,040	187,621						
1904	[2]2,854	109,719	659,000	221,000						
1905	1,462	51,937	489,000	219,500						
1906	1,066	38,909	365,000	160,000						
1907	802	30,604	304,340	130,936						
1908	1,300	54,951	246,545	118,300			$10,000			
1909	1,075	56,277	265,000	108,270					$28,423	Unapportioned, 1900-1909.
1910	1,048	47,422	212,546	95,005						
1911	899	41,363	227.440	58,933						
1912	209	8,786	202,000	114,500						
1913	395	15,891	209,750	109,938						
1914	331	16,236	254,150	47,267						
1915	492	41,660	165,130	24,371			5,000		1,503	Copper, gold, silver.
1916	1 139	106,496	195,650	54,160	871	$15,070	4,500		770	Other minerals.
1917	1,067	107,071	129,157	22,685	1,466	36,326	2,500	85 tons 	1,900 70	Manganese. Other minerals.
1918	1,540	172,173	87,067	15,006	476	24,790	1,000		2,907	Manganese and natural gas.
1919	229	20,604	62,839	17,471	[3]		1,200		100	Other minerals.
1920	385	24,314	43,693	16,413	84	1,560	13,200	247 tons 	7,816 250	Manganese. Other minerals.
1921	22	880	54,715	26.751			146,508		250	Other minerals.
Totals	253,082	$9,893,935	7,109,858	$2,304,869	[3]2,897	77,746	$183,908		$43,989	

*Bartlett since 1888 and Witter since 1889 reported to U. S. Geological Survey, but no segregated figures available for Lake County, previous to 1895.

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Flasks of 75 pounds, beginning June 1, 1904. Previously 76½ pounds.

[3] See under 'Unapportioned.'

In addition to the above, Lake County has produced the following:

Borax	Sulphur	Pounds	Value
1864 to 1868 Borax Lake yielded 590 tons refined borax, worth $414,636; 1872 from Lake Hachinhama, 140 tons, worth $89,600; total 730 tons, worth $504,236.	1865	214,650	$8,030
	1866	675,963	21,970
	1867	487,603	13,420
	1868	503,481	10,080
	Totals	1,881,697	$53,500

LASSEN COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Miscellaneous stone, value	Miscellaneous and unapportioned		
				Amount	Value	Substance
1880	$25,900					
1881	71,000	$1,000				
1882	100,000	20,000				
1883	20,000	5,000				
1884	[1]119,060	341				
1885	15,000	150				
1886	25,812	135				
1887	24,108	304				
1888	50,000	200				
1889	97,503	215				
1890	14,890	300				
1891	3,676					
1892	15,400					
1893						
1894	35,283					
1895	25,000					
1896	40,300					
1897	49,100	850				
1898	37,460	300				
1899	28,898					
1900	19,807	676				
1901	5,900	200				
1902	23,410	244				
1903	91,102	1,203				
1904	116,993	1,515				
1905						
1906	[2]	[2]				
1907	[2]	[2]				
1908	7,284	783				
1909	[3]116,327	[3]1,463			$217,521	Unapportioned, 1900-1909.
1910	[4]82,180	[4]972				
1911	[2]	[2]			1,522	Gold and silver.
1912						
1913		2	$2,030			[5]
1914	1,250	4	775			[5]
1915			870			
1916			9,725			
1917			376			
1918			800			
1919			1,100			
1920			7,313		5,000	Other minerals.
1921	39,943	1,234	42,308			
Totals	[2]$1,303,586	[2]$37,091	$65,297		$224,043	

[1] Lawver, A. M., in 'Production of Precious Metals in U. S.': Report of Director of Mint, 1884, p. 175, 1885.

[2] See under 'Unapportioned.'

[3] Includes Modoc and Colusa Counties' production.

[4] Includes Colusa county production.

[5] Copper production erroneously reported from Lassen County in the years 1913 and 1914, on account of shipping point being Doyle, while producing copper mines were located in Plumas County.

LOS ANGELES COUNTY

(See Page 665)

MADERA

Year	Gold, value	Silver, value	Copper		Brick	
			Pounds	Value	M.	Value
1893	[1]$150,696	$314				
1894	107,791	180				
1895	162,323					
1896	104,339	1,240				
1897	85,963					
1898	94,884	50			400	$2,800
1899	73,758	292			439	3,070
1900	104,134	3,833	500,000	$77,500	500	3,000
1901	82,749	2,600	108,430	17,077	500	3,000
1902	35,128	3	18,600	2,139	230	1,840
1903	93,070	3	36,000	4,680	216	972
1904	75,303	25	10,300	1,313	750	3,750
1905	50,867	10,014				
1906	22,390	508				
1907	13,303	506	1,895	379	1,250	12,500
1908	45,107	1,264	113,293	15,454	250	2,250
1909	14,716	403	5,000	635		
1910	10,076	1,850	336,667	42,876	740	3,700
1911	1,958	77	14,608	1,826	270	1,350
1912	9,162	1,162	248,129	40,941	300	1,500
1913	14,489	1,617	532,403	82,522	315	1,650
1914	4,506	36	35,359	4,703		
1915	11,214	2,126	40,294	7,051	200	1,400
1916	10,306	1,772	124,286	30,574		
1917	18,914	489	372,123	101,590		
1918	7,583	4,206	245,519	60,643		
1919	17,705	1,700	175,405	32,625		
1920	6,382	1,488	89,846	16,532		
1921	1,053	27				
Totals	$1,429,869	$37,785	3,008,157	$541,060	6,360	$42,782

[1] Madera County created March 11, 1893, from a portion of Fresno County. Between 80 per cent and 90 per cent of the gold and silver produced in Fresno County prior to 1893 was from that part now in Madera County.

[2] Includes crushed rock, rubble, rip-rap, sand, gravel.

MARIN COUNTY,

Year	Brick		Miscellaneous stone[1]	
	M.	Value	Tons	Value
1888	1,600	$10,000		
1889	*2,000	12,000		
1890	*5,000	30,000		
1891	*10,000	60,000		
1892	*12,000	72,000		
1893	18,000	108,000		
1894	28,500	172,500		$16,850
1895	29,000	145,000		7,790
1896	15,000	85 000	7,849	8,260
1897	15,000	89,000	6,000	7.200
1898	15,500	66 000	1,710	1,800
1899	16,500	76,000	4,400	5,150
1900	25,000	200,000	3,000	2,500
1901	14,320	100 240	34,000	27,987
1902	14,600	97,700	149,450	105,350
1903	13,819	78,095	144,715	140,332
1904	20,500	132,000	216,576	170,995
1905	22,877	163,585	113,000	44,250
1906	23,900	199,300	54,000	53,000
1907	16,000	118,000	157,100	134,111
1908	10,000	50,000	111,686	66,700
1909	4,500	105,000	132,010	67,010
1910	22,497	99,185	112,000	74,700
1911	19,695	87,445	173,646	108,786
1912	18,000	88,200	5,300	3,000
1913	16,000	70,500	428,357	198,953
1914	15,000	55,000		490,137
1915	10,000	50,000		101,528
1916	[2]			74,000
1917	[2]			158,582
1918	[2]			89,458
1919	[2]			127,111
1920	[2]			208,302
1921	[2]			202,333
Totals	[2]434,808	$2,619,750		$2,696,175

*Estimated.

[1] Includes crushed rock, rubble, rip-rap, sand, gravel

[2] See under 'Unapportioned.'

COUNTY, 1893[1]-1921.

Granite		Miscellaneous stone[2], value	Miscellaneous and unapportioned		
Cubic feet	Value		Amount	Value	Substance
------------	------------	------------	------------	------------	
48,858	$31,494	------------	------------	------------	
39,590	49,662	------------	------------	------------	
48,628	73,525	$7,800	------------	------------	
39,030	37,215	1,249	------------	------------	
23,103	49,673	500	------------	------------	
47,433	36,000	2,500	------------	------------	
124,015	80,000	------------	------------	$65,000	Unapportioned, 1900-1909.
96,716	294,799	600	------------	------------	
105,845	78,041	4,000	------------	------------	
128,581	389,800	1,000	------------	------------	
113,627	98,083	500	------------	------------	
42,316	123,106	------------	------------	------------	
65,472	176,416	------------	------------	------------	
99,278	93,372	------------	------------	------------	
140,086	123,668	2,140	2,279 lbs.	84	Lead.
142,622	111,380	5,836	------------	------------	
99,192	74,152	1,112	------------	------------	
99,900	74,190	800	------------	------------	
82,135	56,058	3,213	5,533 lbs.	249	Lead.
150,994	270,123	1,466	------------	------------	
------------	186,543	6,221	50 tons	1,000	Pumice.
------------	84,632	37,640	------------	1,000	Other minerals.
128,865	172,191	7,915	------------	------------	
------------	114,400	1,525	221 lbs.	19	Lead.
------------	40,355	1,540	------------	------------	
------------	64,358	1,500	------------	------------	
------------	98,523	------------	------------	------------	
------------	461,822	4,765	------------	------------	
------------	$3,543,581	$93,822	------------	$67,352	

1888-1921.

Mineral water		Miscellaneous and unapportioned		
Gallons	Value	Amount	Value	Substance
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	7,000 cu. ft	$5,000	Granite
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	700 tons	1,400	Salt.
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	------------	------------	
------------	------------	150 tons	300	Salt.
------------	------------	------------	------------	
52,000	$12,050	------------	------------	
47,500	5,075	------------	42,000	Unapportioned, 1900-1909.
100,000	10,000	------------	------------	
328,740	36,500	------------	------------	
260,000	31,000	------------	------------	
60,000	9,000	------------	------------	
60,000	9,000	------------	------------	
60,000	9,000	------------	------------	
[2]	------------	------------	74,000	Brick and mineral water.
[2]	------------	------------	113,720	Brick and mineral water.
[2]	------------	------------	86,725	Brick, copper, gold, mineral water, silver.
[2]	------------	------------	101,863	Brick and mineral water.
[2]	------------	------------	127,443	Brick and mineral water.
[2]	------------	------------	116,443	Brick and mineral water.
[2]962,240	$121,625	------------	$668,894	

MARIPOSA COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Copper		Miscellaneous and unapportioned		
			Pounds	Value	Amount	Value	Substance
1880	$150,017	$1,300					
1881	200,000	1,200					
1882	250,000	4,000					
1883	220,000	3,000					
1884	180,000						
1885	149,177	100					
1886	197,600						
1887	187,165	96					
1888	175,000	250					
1889	145.819	210					
1890	124,265	22					
1891	84,414						
1892	81,011	67					
1893	164,116	307					
1894	153,708	39					
1895	216,622	7					
1896	335,637	180					
1897	451,427	660					
1898	336,418	993					
1899	562,829	2,207			110 sq'r's	$600	Slate.
1900	157,663	13,853					
1901	504,928	4,787	191,622	$30,180	70,000 lbs.	3,080	Lead.
1902	631,478	3,880	104,700	11,940			
1903	542,355	3,353	61,627	6.808			
1904	429,771	2,839	11,500	1,466			
1905	386,380	5,231	12,541	1,956		25	Platinum.
1906	366,394	3,377					
1907	405,498	4,500			1,142 lbs.	60	Lead.
1908	439,862	4,732	29,124	2,958		36,560	Miscellaneous stone.
1909	396,465	2,729				62,430 8,431	Miscellaneous stone. Unapportioned, 1900-1909
1910	317.580	2,364			 800 tons	21,501 4,800	Miscellaneous stone. Barytes.
1911	172,532	1,390	14,641	1,830			
1912	160,541	6,796	284,587	46,957			
1913	171,034	7,430	416,031	64,485		3,130	Other minerals.
1914	131,458	677	277,472	36,904	 2,000 tons 100 cu. ft.	15,366 3,000 100	Miscellaneous stone. Barytes. Marble.
1915	385,577	2,175	38,630	6,760		17,214 600	Miscellaneous stone. Other minerals.
1916	401,718	2,680	162,318	39,930	1,857 lbs.	128 4,143 39,372	Lead. Other minerals. Miscellaneous stone.
1917	313,296	3,221	53.381	14,583	1,075 lbs.	92 13,399 7,646	Lead. Other minerals. Miscellaneous stone.
1918	337,682	5,083	30,294	7,483		1,856 400	Chromite and lead. Miscellaneous stone.
1919	253,392	4,139	24,879	4,627		8 400	Other minerals. Miscellaneous stone.
1920	261,830	4,705	[1]			4,096 400	Barytes, copper, lead. Miscellaneous stone.
1921	331,295	5,251				5,655 400	Barytes and pyrites. Miscellaneous stone.
Totals	$11,863,954	$109,830	[1]1,713,347	$278 867		$254,892	

[1] See under 'Unapportioned.'

PHYSICAL
SCIENCES
LIBRARY

LOS ANGELES COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Petroleum		Asphalt—Natural gas (Tons) (M. cu. ft.)		Gypsum		Salt		Gems, value	Mineral water		Brick		Pottery clay		Sandstone and serpentine		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Barrels	Value	Amount	Value	Tons	Value	Tons	Value		Gallons	Value	M.	Value	Tons	Value	Cubic feet	Value		Amount	Value	Substance
1880	$7,700	$66,300	*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1881	13,000	39,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1882	17,000	24,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1883	20,000	25,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1884	40,000	11,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1885	22,500	1,945	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1886	21,500	6,750	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1887	25,000	25,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1888	20,000	10,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1889	38,203	97	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1890	74,320	7,266	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1891	40,759	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1892	219,204	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1893	14,200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1894	34,500	-----	475,650	$617,065	-----	-----	1,134	$11,340	-----	-----	-----	-----	-----	7,500	$37,500	-----	-----	-----	-----	$5,500	9,500 bbls.	$10,800	Lime.
1895	23,330	-----	979,695	732,817	-----	-----	3,790	37,820	-----	-----	-----	-----	-----	45,800	235,000	-----	-----	-----	-----	47,750	-----	-----	
1896	35,468	-----	953,734	812,800	-----	-----	960	9,180	-----	-----	-----	-----	-----	27,478	179,290	-----	-----	[7]1,500	$6,000	30,000	-----	-----	
1897	40,698	-----	1,327,011	1,327,011	-----	-----	1,900	17,250	-----	-----	-----	-----	-----	36,868	228,290	-----	-----	[7]2,500	2,500	30,625	5 tons	200	Infusorial earth.
1898	21,300	-----	1,462,871	1,462,871	-----	-----	2,500	18,500	-----	-----	-----	-----	-----	25,908	188,386	50	$500	[6]10,500 [7]750	5,250 3,000	32,500	2 tons	50	Sulphur.
1899	13,132	-----	1,409,356	1,409,356	[2]1,151	$23,020	3,563	14,250	-----	-----	-----	193,500	$5,805	23,385	147,400	-----	-----	[6]6,000	3,000	112,001	1,600 cu. ft.	2,000	Marble.
1900	5,508	-----	1,722,887	1,722,887	[2]5,000	100,000	2,500	10,000	-----	-----	-----	-----	-----	55,725	275,925	4,576	10,776	[6]7,500	3,750	24,352	-----	-----	
1901	10,312	-----	2,304,432	1,062,038	----- [2]10,000	[3]1,500 152,838	3,500	35,500	6,650	$19,950	-----	-----	-----	44,435	264,825	130	390	[7]350 [7]89	2,000 90	94,229	10 tons	19	Soapstone.
1902	7,209	-----	2,198,496	1,075,868	[2]16,767	171,904	-----	-----	90	180	-----	-----	-----	52,776	335,670	890	890	-----	-----	105,047	100 tons 14,400 lbs. 60 tons	300 504 360	Mineral paint. Lead. Infusorial earth.
1903	8,674	22	1,960,604	1,294,866	[2]28,308	332,600	5,914	38,441	8,000	20,000	-----	95,000	5,500	79,195	706,334	115	115	[6]2,163	9,734	118,185	1,736 tons 219 tons	2,558 10,124	Glass sand. Soapstone.
1904	12,402	73	2,190,000	1,289,910	[2]30,425	307,068	-----	-----	7,560	24,480	-----	125,750	7,084	128,719	767,827	5,000	5,000	[6]29,211 [7]200	13,145 2,310	83,826	10,000 bbls. 709 tons 228 tons	10,000 4,254 2,315	Lime. Glass sand. Soapstone.
1905	15,035	100	2,854,564	1,056,188	[2]23,718	119,430	11,500	43,500	12,000	20,000	-----	175,000	31,250	109,563	853,810	30,533	16,066	[6]8,784	9,950	69,021	-----	-----	
1906	-----	-----	2,814,000	908,800	[2]25,920	259,200	21,000	69,000	12,000	36,000	-----	85,465	5,128	127,965	826,831	41,350	34,250	[6]19,080 [7]847	9,540 1,694	176,558	18,000 bbls. 50 tons	18,000 200	Lime. Infusorial earth.
1907	-----	-----	4,318,739	2,633,541	[2]26,610	353,423	7,500	50,000	12,000	36,000	-----	385,000	35,100	101,079	895,272	17,500	20,500	[6]21,196 [7]1,000	19,076 3,000	36,904	849 lbs. 1,000 cu. ft. 25,000 bbls.	169 3,000 25,000	Copper. Marble Lime.
1908	-----	-----	6,244,347	4,082,052	[2]25,000	250,000	12,000	75,000	12,000	48,000	$8,500	573,975	42,857	108,414	800,163	25,934	55,274	[6]6,292	2,000	598,618	200 tons	8,000	Glass sand.
1909	864	2	5,409,392	3,513,192	[2]40,740	516,500	10,000	50,000	10,000	30,000	9,500	266,315	19 988	136,202	1,195,892	14,027	26,688	-----	-----	182,377	1,800 tons 2,000 cu. ft. -----	14,400 6,000 842,530	Glass sand. Marble. Unapportioned, 1900-1909
1910	-----	-----	5,127,266	3,185,433	[2]45,872 [3]30,920	591,193 15,208	-----	-----	6,000	12,000	4,900	319,491	23,999	148,723	1,361,653	450	800	-----	-----	324,091	40 tons 60 tons 80 tons 1,600 cu. ft.	320 720 200 4,800	Infusorial earth. Feldspar. Glass sand. Marble.
1911	[4]	-----	4,924,288	3,313,972	-----	[3]15,208	-----	-----	7,592	16,113	5,000	229,019	17,256	160,259	1,442,913	15,650	41,025	-----	-----	553,076	1,100 cu. ft.	3,300	Marble.
1912	[5]	-----	4,484,590	2,798,384	-----	[3]78,672	-----	-----	10,360	46,370	3,000	76,495	6,333	174,862	1,692,258	11 929	12 028	-----	-----	955 668	1 800 tons	1 800	Glass sand.
1913	2,322	27	4,143,690	2,672,680	[3]1,287,794	77,578	-----	-----	10,000	40,000	2,500	255,095	15,140	204 912	1 752,106	7,425	20,135	-----	-----	1,008,810	1,800 tons -----	2,000 240,000	Glass sand. Other minerals.
1914	-----	-----	3,558,690	1,957,279	[3]1,250,000	75,000	-----	-----	20,000	60,000	2,100	331,151	8,025	133,557	1,244,971	8,263	14,566	-----	-----	953,434	13,203 tons 10 tons	349,669 460	Borax. Potash.
1915	-----	-----	2,931,098	1,843,661	[3]1,729,035	120,783	-----	-----	-----	-----	700	350,171	29,491	88,669	820,312	6,507	1,511	-----	-----	1,022,134	-----	330,020	Barite, borax, potash.
1916	-----	-----	2,875,468	1,871,930	[3]2,083,664	139,522	-----	-----	[8]	-----	600	320,700	8,552	82,005	760,912	6,233	10,549	-----	-----	971,153	1,864 tons 612 tons -----	324,769 1,684 373,374	Potash. Silica. Borax, copper, graphite, salt.
1917	-----	-----	4,669,583	5,491,430	[3]1,670,476	194,793	-----	-----	[8]	-----	300	188,368	16,902	and tile	939,081	6,276	10,321	[8]	-----	608,026	1,710 tons -----	400,902 542,768	Potash. Borax, graphite, magnesium chloride salt, silica, serpentine, talc.
1918	-----	-----	10,125,190	13,567,755	[3]2,088,959	224,279	-----	-----	[8]	-----	[8]	110,481	15,540	48,381	668,676	12,634	11,820	[8]	-----	547,190	18,630 tons 2,380 tons -----	121,903 462,600 386,865	Building tile. Potash. Borax, gems, graphite, magnesium chloride, manganese, salt, serpentine.
1919	-----	-----	15,076,633	20,805,754	[3]4,148,476	458,812	-----	-----	[8]	-----	[8]	125,400	8,787	and tile	1,185,154	11,329	33,343	-----	-----	715,524	-----	399,007	Borax, gems, graphite, magnesium salts, manganese, salt.
1920	[8]	[8]	14,026,536	21,488,653	[3]6,225,835	556,465	-----	-----	6,502	6,577	-----	161,466	10,371	127,854	2,333,941	18,684	91,763	-----	-----	1,704,951	27,954 tons -----	308,476 473,966	Building tile. Borax, copper, gold, graphite, infusorial earth, lead, magnesium salts, silver.
1921	[8]	[8]	12,395,605	25,795,254	[3]6,944,277	638,936	-----	-----	[8]	-----	[8]	264,468	13,314	and tile	3,208,448	29,055	62,866	-----	-----	1,763,180	-----	222,943	Borax, gems, gold, graphite, limestone, magnesium chloride, salt, silver.
Totals	[8]$804,140	[8]$216,582	122,964,415	$129,793,447	-----	$5,773,932	87,761	$479,781	[8]140,754	$406,670	[8]$45,200	4,632,310	$326.422	-----	$25,348,840	274,540	$481,176	-----	[8]$99,039	$12,874,735	-----	$5,913,329	

---

*Commercial production of petroleum in Los Angeles began at least as early as 1874, in the Newhall district, but detailed county segregations are not available for the early years.

[1] Includes granite, crushed rock, rubble, paving blocks, sand, gravel.

[2] Asphalt, tons.

[3] Natural gas, thousand cubic feet.

[4] Included in Riverside County production.

[5] Included in Monterey County production.

[6] Sandstone.

[7] Serpentine.

[8] See under 'Unapportioned.'

PHYSICAL
SCIENCES
LIBRARY

MENDOCINO

Year	Brick		Manganese ore	
	M.	Value	Tons	Value
1880				
1881				
1882				
1895				
1896				
1898	258	$1,080		
1899	200	1,800		
1900	25	400		
1901	200	2,500		
1902	200	2,000		
1903	550	5,580		
1904	260	3,120		
1905	635	6,470		
1906	500	5,000		
1907	400	4,000		
1908	260	2,600		
1909	150	1,500		
1910				
1911	160	1,600		
1912				
1913				
1914				
1915			2,858	$23,036
1916			1,735	43,005
1917	[2]		1,541	40,515
1918			1,432	58,962
1919				
1920			[2]	
1921	[2]		[2]	
Totals	[2]3,798	$37,650	[2]7,566	$165,518

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] See under 'Unapportioned.'

COUNTY, 1880-1921.

Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value		Amount	Value	Substance
				$733	Gold.
				125	Silver.
				1,000	Gold.
			50 tons	150	Coal.
			450 tons	2,250	Bituminous rock.
17,470	$6,988				
24,875	8,048				
27,950	8,220				
28,575	7,898				
38,900	15,000				
40,000	12,000			75	Gold.
90,000	18,000			40	Gold.
40,000	9.800			19	Gold.
45,000	9,800				
45,000	9,800				
45,000	9,000	$1,200		18,000	Unapportioned, 1900-1909.
		500			
		300			
		9,450			
		560			
		1,500			
		8,275	300 tons	2,400	Magnesite.
				2,000	Other minerals.
		5,600		4,300	Brick, chromite, magnesite.
		5,000		226	Gold, platinum.
			555 tons	44,200	Chromite.
		7,000		7,214	Chromite, platinum.
		7,500		18,610	Chromite, manganese, natural gas, platinum.
				1,509	Gold.
		40,000		13	Silver.
				3,200	Brick, manganese, natural gas, platinum.
442,770	$114,554	$86,885		$106,064	

MERCED COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Copper		Brick		Miscellaneous and unapportioned		
			Pounds	Value	M.	Value	Amount	Value	Substance
1880	$17,515								
1881	1,500								
1882	10,000								
1883	10,000								
1884	6,500								
1885	10,000								
1886	7,000								
1887	10,767	$5							
1888	10,000								
1889	4,843								
1890	2,000	59							
1891	1,728	17							
1892	445								
1893									
1894	763								
1895	1,500								
1896	1,250								
1897									
1898									
1899									
1900	[1]								
1901	[1]		79,071	$12,453					
1902	[1]		14,400	1,656					
1903	[1]		6,000	780					
1904	[1]		8,900	1,135					
1905	[1]				600	$3,500			
1906					650	6,000			
1907	822	10			1,250	12,500			
1908	[2]182,970	[2]1,196	694	70	700	6,300	965 lbs.	$36	Lead.
1909	[2]228,492	[2]572			700	6,300		18,264	Unapportioned.
1910	[1]	[1]			700	6,300		64,764	Miscellaneous stone.
1911	[1]	[1]						49,548	Miscellaneous stone.
1912	[1]	[1]						45,000	Miscellaneous stone.
1913	[4]2,255	[4]92	19,240	2,982				30,000	Miscellaneous stone.
1914	[2]111,361	[2]340							
1915	[3]	[3]					690 lbs.	32 94,000	Lead. Other minerals.
1916	[3]	[3]					90 tons	720 80,810	Magnesite. Gold, platinum, silver.
1917	[3]	[3]						70,500 76,616	Miscellaneous stone. Gold, platinum, silver.
1918	41,089	254						32,500 1,006	Miscellaneous stone. Other minerals.
1919	[1]	[1]						40,350	Miscellaneous stone.
1920								24,800	Miscellaneous stone.
1921	3,163	87						30,300	Miscellaneous stone.
Totals	[3]$665,963	[3]$2,632	128,305	$19,076	4,600	$40,900		$659,246	

[1] Included with Stanislaus County production.
[2] Includes Stanislaus County production.
[3] See under 'Unapportioned.'
[4] Dredge output included under Stanislaus County.

MODOC COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Salt		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Tons	Value		Amount	Value	Substance
1880	$10,000							
1881	20,000	$1,500						
1882								
1883	50,000							
1884	60,000							
1885	60,000							
1886								
1909	[2]							
1910	5,438	75						
1911	19,875	363						
1912	27,893	494	50	$800				
1913	6,061	94	40	720				
1914	1,000	10	40	720				
1915	7,557	104	[3]		$300		$720	Other minerals.
1916	2,729	90	[3]		200		540	Other minerals.
1917					200			
1918	[3]	[3]	[3]		200		8,020	Gold, salt, silver.
1919	6,478	390	[3]		550		1,802	Other minerals.
1920	[3]	[3]	[3]		700		3,968	Gem material (Iceland Spar) gold, salt, silver.
1921			[3]		34,930		1,720	Gem material (Iceland Spar) and salt.
Totals	[3]$277,031	[3]$3,120	[3]130	$2,240	$37,080		$16,770	

[1] Includes crushed rock, rubble, sand, gravel.
[2] Included under Lassen County production.
[3] See under 'Unapportioned '

MONO COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Lead		Lime		Miscellaneous and unapportioned		
			Pounds	Value	Barrels	Value	Amount	Value	Substance
1880	$2,407,236	$582,905	--------	--------	--------	--------	--------	--------	
1881	3,385,000	300,000	--------	--------	--------	--------	--------	--------	
1882	2,200,000	380,000	--------	--------	--------	--------	--------	--------	
1883	1,750,000	290,000	--------	--------	--------	--------	--------	--------	
1884	1,000,000	285,000	--------	--------	--------	--------	--------	--------	
1885	482,860	91,849	--------	--------	--------	--------	--------	--------	
1886	439,558	163,502	--------	--------	--------	--------	--------	--------	
1887	382,498	118,945	--------	--------	--------	--------	--------	--------	
1888	297,000	75,000	--------	--------	--------	--------	--------	--------	
1889	193,264	86,827	--------	--------	--------	--------	--------	--------	
1890	144,180	52,293	--------	--------	--------	--------	--------	--------	
1891	302,415	18,983	--------	--------	--------	--------	--------	--------	
1892	396,296	271,058	--------	--------	--------	--------	--------	--------	
1893	293,637	11,401	--------	--------	--------	--------	--------	--------	
1894	358,824	11,549	50,000	$1,500	--------	--------	--------	--------	
1895	552,690	84,910	94,400	2,926	--------	--------	800 cu. ft.	$8,000	Onyx.
1896	451,553	82,283	73,500	2,205	500	$2,000	3,000 cu. ft.	24,000	Onyx.
1897	520,101	72,491	32,000	1,088	1,200	4,800	--------	--------	
1898	446,017	66,667	75,000	2,737	3,000	4,000	--------	--------	
1899	697,069	47.547	28,000	1,190	1.200	3,750	--------	--------	
1900	670,200	75.921	50,000	2,000	1,100	4,000	--------	--------	
1901	493,355	25,091	29,000	1,160	2,000	3,000	1.938 lbs.	305	Copper.
1902	510,596	36,548	4,400	154	2,000	2,000	--------	--------	
1903	334,713	20,067	1,000	36	1,818	5,000	1.600 lbs.	208	Copper.
1904	268,930	2,955	--------	--------	215	850	--------	--------	
1905	308,884	11,240	--------	--------	--------	--------	--------	--------	
1906	338,698	13,151	--------	--------	--------	--------	--------	--------	
1907	383,971	29,797	--------	--------	--------	--------	--------	--------	
1908	413,946	26,134	--------	--------	--------	--------	7,100 gals.	5,575	Mineral water.
1909	354,909	37,792	--------	--------	--------	--------	--------	106,772	Unapportioned, 1900-1909.
1910	435,724	9,391	--------	--------	--------	--------	--------	--------	
1911	261,232	35,508	37,000	1,665	--------	--------	--------	--------	
1912	377,518	70,602	23,936	1,077	4,961	3,721	8,179 lbs.	1.350	Copper.
1913	147,271	23,263	--------	--------	2,135	1,600	79,319 lbs.	12,294	Copper.
1914	7,000	10,000	--------	--------	--------	--------	1,000 lbs.	150	Salt.
1915	107,302	1,923	--------	--------	--------	--------	--------	200	Other minerals.
1916	237,084	3,606	--------	--------	--------	--------	--------	300	Other minerals.
1917	209,040	5,662	1,912	164	--------	--------	--------	3,906	Copper, molybde salt.
1918	31,252	22,727	1,318	94	--------	--------	160 lbs.	40	Copper.
							--------	750	Other minerals.
1919	29,428	55,558	1,556	82	--------	--------	539 lbs.	100	Copper.
1920	144,746	34,369	85,014	6,801	--------	--------	3,215 lbs.	592	Copper.
							--------	1,000	Miscellaneous stone.
							--------	750	Other minerals.
1921	37,754	15,160	42,962	1,933	--------	--------	2,940 lbs.	379	Copper.
							--------	1,650	Onyx and salt.
Totals	$22,803,751	$3,659,675	630,998	$26,812	20,129	$34,721	--------	$168,321	

MONTEREY

Year	Gold, value	Silver, value	Brick		Diatomaceous earth		Lime		Limestone	
			M.	Value	Tons	Value	Barrels	Value	Tons	Value
1889	$3,500									
1890	11,815									
1891	3,000									
1892										
1893										
1894	8,000									
1895										
1896										
1897									2,000	$2,000
1898			400	$2,400					2,049	1,640
1899			200	1,400					7,744	6,970
1900			200	1,600					8,000	10,800
1901	13,800								5,463	7,500
1902	6,860	$18					22,000	$13,200		
1903	8,920						26,000	23,400	6,516	9,000
1904	6,941		200	1,600			3,240	3,240	4,550	21,500
1905	4,000						10,000	10,000		
1906	625	3			80	$400	40,000	50,000		
1907	1,076	9					100,000	125,000		
1908	1,318	9	426	3,838			50,000	50,000		
1909	333	5	300	2,900	500	3,500	50,006	62,507	10,658	45,678
1910	[2]1,013	10	993	9,957	500	3,500	30,894	29,349	2,500	7,500
1911					850	5,950			2,000	6,000
1912	[3]7,647	67							6,000	8 000
1913	6,491	27			1,700	6,800			6,500	13,000
1914	4,000	20								
1915					[4]					
1916					[4]					
1917					[4]				[4]	
1918					[4]					
1919					[4]					
1920					[4]					
1921					[4]					
Totals	$89,339	$168	2,719	$23,695	[4]3,630	$20,150	332,140	$366,696	[4]63,980	$139,588

[1] Includes crushed rock, rubble, sand, gravel.
[2] Includes Monterey, San Luis Obispo and Santa Cruz counties.
[3] Includes Los Angeles and San Luis Obispo counties.
[4] See under 'Unapportioned.'
[5] Includes molding, building, blast, filter, roofing sand.

COUNTY, 1889-1921.

Mineral water		Glass sand		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value	Tons	Value		Amount	Value	Substance
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	$1,500	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
5,000	$1,000	-----	-----	-----	-----	-----	
2,000	200	-----	-----	-----	-----	-----	
21,000	1,050	-----	-----	14,025	-----	-----	
1,500	750	-----	-----	8,258	-----	-----	
20,000	4,000	-----	-----	2,775	-----	-----	
15,000	3,250	4,500	$15,750	8,869	200 tons	$1,000	Coal.
15,000	1,750	4,500	12,225	5,200	-----	-----	
55,000	1,250	5,989	4,967	3,167	61 tons	732	Asphaltum.
25,000	1,000	8,295	7,272	-----	124 tons	1,488	Asphaltum.
5,000	1,000	9,257	8,127	-----	-----	-----	
24,000	12,000	750	1,125	-----	-----	-----	
120,000	12,000	11,065	8,178	-----	4,800 tons	24,000	Coal.
-----	-----	6,805	5,120	31,727	7 flasks	296	Quicksilver.
10,000	2,000	6,496	4,872	43,351	1 flask	49	Quicksilver.
					-----	344,789	Unapportioned, 1900-1909.
-----	-----	7,594	5,890	47,487	7 flasks	317	Quicksilver.
					700 tons	5,000	Feldspar.
					200 tons	2,500	Fuller's earth.
-----	-----	-----	-----	27,011	11,000 tons	4,950	Clay.
20,000	7,000	9,016	7,916	60,119	4,000 tons	6,000	Clay.
20,000	7,000	9,141	9,192	12,556	320 tons	3,200	Coal.
					-----	78,332	Other minerals.
					35,000 tons	12,000	Clay.
26,000	7,900	9,210	7,633	39,202	300 tons	2,700	Fuller's earth.
					5,992 tons	17,976	Coal.
					-----	9,450	Other minerals.
					700 tons	3,500	Feldspar.
					450 tons	3,150	Fuller's earth.
8,200	2,050	[4]	-----	32,799	-----	50,137	Coal, feldspar, diatomaceous earth, quicksilver, silica.
5,900	590	-----	-----	58,623	-----	50,659	Barytes, feldspar, diatomaceous earth quicksilver, salt, silica.
[4]	-----	[4]	-----	57,810	6,392 tons	23,468	Dolomite.
					-----	57,508	Barytes, diatomaceous earth, limestone, mineral water, quicksilver salt, silica.
-----	-----	[4]	-----	52,697	4,900 tons	25,950	Dolomite.
					700 tons	3,800	Feldspar.
					-----	37,240	Barytes, coal, diatomaceous earth, quicksilver, salt, silica.
-----	-----	[4]	-----	73,031	8,280 tons	29,120	Dolomite.
					-----	43,353	Barytes, coal, feldspar, diatomaceous earth, salt silica.
200	20	[4]	-----	[5]84,056	5,755 tons	26,238	Dolomite.
					-----	16,135	Barytes, coal, feldspar, diatomaceous earth, salt, silica (glass sand).
-----	-----	[4]	-----	[5]63,316	2,500 tons	8,750	Dolomite.
					-----	98,089	Asbestos, coal, diatomaceous earth mineral water, salt, glass sand
[4]398,800	$65,810	[4]92,618	$98,261	$727,579	-----	$991,876	

NAPA COUNTY,

Year	Quicksilver		Mineral water	
	Flasks	Value	Gallons	Value
Manhattan Mine output, 1863 to 1876	3,594	$235,876	[2]	------------
1862	444	16,139	------------	------------
1863	852	35,852	------------	------------
1864	2,714	124,573	------------	------------
1865	3,545	162,716	------------	------------
1866	2,254	119,755	------------	------------
1867	7,862	360,866	------------	------------
1868	9,808	450,187	------------	------------
1869	6,598	302,848	------------	------------
1870	5,766	330,853	------------	------------
1871	4,098	258,584	------------	------------
1872	4,876	321,475	------------	------------
1873	5,266	423,018	------------	------------
1874	11,705	1,231,132	------------	------------
1875	9,453	795,470	------------	------------
1876	11,303	497,332	------------	------------
1877	13,127	489,637	------------	------------
1878	10,810	355,649	------------	------------
1879	9,446	281,961	------------	------------
1880	6,830	211,730	------------	------------
1881	7,746	231,063	------------	------------
1882	9,013	254,467	------------	------------
1883	7,784	223,790	------------	------------
1884	5,188	158,234	------------	------------
1885	3,891	119,648	------------	------------
1886	5,656	200,788	------------	------------
1887	6,247	264,717	------------	------------
1888	5,150	218,875	------------	------------
1889	5,402	243,090	------------	------------
1890	3,934	206,535	------------	------------
1891	4,896	221,544	------------	------------
1892	8,612	350,595	------------	------------
1893	11,505	422,809	------------	------------
1894	9,705	298,016	97,275	$41,231
1895	9,318	372,500	199,397	99,700
1896	11,411	403,031	218,680	81,335
1897	12,281	459,753	159,896	81,948
1898	12,368	472,972	169,261	63,919
1899	11,696	598,322	171,567	85,964
1900	8,724	403,500	171,000	72,200
1901	7,798	388,176	158,830	109,900
1902	7,142	304,474	236,229	97,048
1903	7,859	333,006	244,400	124,000
1904	[3]5,328	199,586	386,000	104,750
1905	4,853	171,910	279,400	89,500
1906	2,380	86,870	84,000	90,500
1907	2,500	95,400	240,000	103,600
1908	2,340	98,912	145,500	101,090
1909	1,625	80,535	123,072	96,279
1910	646	29,231	152,772	92,960
1911	140	6,441	141,540	86,530
1912	287	12,065	136,750	81,997
1913	287	11,546	151,520	75,548
1914	240	11,772	142,940	73,280
1915	507	45,224	133,387	73,535
1916	1,150	107,525	152,764	93,370
1917	834	78,320	126,124	70,058
1918	1,297	143,850	92,512	59.620
1919	644	58,140	76,860	60,395
1920	266	18,588	80,431	38,621
1921	35	1,659	72,364	55,760
Totals	339,036	$15,412,132	4,544,471	$2,304,638

---

[1] Includes crushed rock, macadam, rubble, paving blocks, sand, gravel paving blocks,

[2] Napa Soda Springs have been bottling water for sale since 1860; but no segregated figures available for Napa County previous to 1894.

[3] Flasks of 76½ pounds to June, 1904; of 75 pounds since.

[4] See under 'Unapportioned.'

1862-1921.

Magnesite		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
				$93,000	Gold and silver.
				5,000	Gold and silver
				16,000	Gold and silver.
				22,500	Gold and silver.
				50,000	Gold and silver.
				95,000	Gold and silver.
				57,046	Gold and silver.
$1,500	$6,000			30,517	Gold and silver.
				23,689	Gold and silver.
1,440	10,240		51 tons	2,040	Infusorial earth.
2,200	17,000				
1,500	11,000				
1,143	13,671				
1,263	19,075				
1,180	17,130				
1,983	17,400				
700	11,622		8,919 tons	6,690	Limestone.
150	450	$500	7,086 tons	8,496	Limestone.
61	915	3,375	290,368 bbls.	435,552	Cement.
12	78	4.019			
		500			
		2,777			
		3,000			
		78,728			
		138,636		3,151,182	Unapportioned, 1900 to 1909.
		122,219		2,893,786	Unapportioned. 1910 to 1913.
		127,428			
55	550	172,646			
		243,759		8,000	Sandstone.
		130,316		756,380	Other minerals.
1,050	9,450	108,387		647.625	Cement, sandstone.
13,960	108,556	88,441	715 tons 119,500 cu. ft.	11,559 5,500 663.586	Chromite. Building stone (tuff). Other minerals.
40,329	387,930	110,039	844 tons	22,020 752,706	Chromite. Cement, clay, copper.
29,163	263,367	82,944	667 tons	38,432 1,088,154	Chromite. Cement, gold, silver.
10,112	86,752	70,016			
[4]		74,550		98,382	Magnesite, volcanic ash.
		111.100		26,720	Other minerals.
[4]107,801	$981,186	$1,673,380		$11,009,562	

NEVADA COUNTY,

Year	Copper		Gold, value	Granite	
	Pounds	Value		Cubic feet	Value
1880	------	------	$2,702,362	------	------
1881	------	------	3,700,000	------	------
1882	------	------	3,500,000	------	------
1883	------	------	3,000,000	------	------
1884	------	------	2,950,000	------	------
1885	------	------	2,577,873	------	------
1886	------	------	3,221,038	------	------
1887	------	------	2,719,574	------	------
1888	------	------	2,600,000	------	------
1889	------	------	2,249,335	------	------
1890	------	------	1,969,613	------	------
1891	------	------	2,207,886	------	------
1892	------	------	1,945,406	------	------
1893	------	------	2,067,203	------	------
1894	83,728	$7,535	1,830,155	------	------
1895	33,255	3,325	1,789,816	------	------
1896	28,200	2,820	2,380,756	------	------
1897	------	------	1,885,251	1,100	$2,200
1898	30,000	3,000	2,017,628	2,000	1,500
1899	43,438	7,084	2,171,510	2,000	1,500
1900	150,980	20,472	1,812,036	------	------
1901	39,588	6,235	2,121,054	------	------
1902	26,500	3,975	2,142,740	1,000	3,000
1903	4,500	585	2,458,047	2,170	4,160
1904	------	------	3,130,304	2,335	5,395
1905	------	------	3,179,715	2,155	2,570
1906	------	------	2,658,420	9,525	9,300
1907	22,082	4,418	2,162,083	12,840	9,300
1908	30,166	4,104	2,297,963	700	2,100
1909	------	------	2,660,235	1,250	2,800
1910	------	------	2,533,483	2,225	3,215
1911	1,665	209	2,199,147	1,250	3,500
1912	------	------	2,081,958	------	------
1913	------	------	2,918,733	------	------
1914	39	5	3,301,948	------	------
1915	1,817	318	3,466,722	------	------
1916	3,487	858	3,669,878	100	100
1917	40,165	10,965	3,682,947	------	------
1918	42,203	10,424	3,070,453	------	------
1919	[2]	------	2,981,312		------
1920	[2]	------	2,872,471		------
1921	------	------	2,570,162		------
Totals	[2]581,813	$86,332	$109,457,217	[2]40,650	$50,640

[1] Includes crushed rock, rubble, sand, gravel.

[2] See under 'Unapportioned.'

1880-1921.

Lead		Silver, value	Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Pounds	Value			Amount, (tons)	Value	Substance
------	------	$70,144	------	------	------	
------	------	9,500	------	------	------	
------	------	10,000	------	------	------	
------	------	8,000	------	------	------	
------	------	5,000	------	------	------	
------	------	4,835	------	------	------	
------	------	8,333	------	------	------	
------	------	2,477	------	------	------	
------	------	5,000	------	------	------	
------	------	5,633	------	------	------	
------	------	14,713	------	------	------	
------	------	14,184	------	------	------	
------	------	8,326	------	------	------	
------	------	1,229	------	------	------	
------	------	476	------	290	$5,800	Mineral paint.
------	------	400	------	150	2,250	Mineral paint.
------	------	8,584	------	------	------	
------	------	8,116	------	------	------	
------	------	19,476	------	50	1,000	Mineral paint.
				6,000	30,000	Pyrite.
------	------	17,784	------	300	5,400	Mineral paint.
				5,400	28,620	Pyrite.
------	------	66,841	------	2,925	17,550	Pyrite.
------	------	18,122	------	78	429	Pyrite.
------	------	6,124	------	------	------	
------	------	3,252	------	------	------	
------	------	9,555	------	------	------	
------	------	32,523	------	------	20	Platinum.
------	------	24,219	------	------	------	
------	------	17,505	------	------	------	
663	$25	21,914	$1,678	------	------	
------	------	24,926	1,874	------	400,000	Unapportioned, 1900-1909.
------	------	16,506		------	------	
14,831	667	15,691	------	------	------	
1,785	80	22,830	------	------	------	
2,090	92	26,542	5,000	------	------	
145	6	27,000	2,108	------	60	Gems.
1,567	74	23,762	3,675	------	1,950	Other minerals.
1,036	71	35,741	1,225	981	12,795	Chromite.
				------	23,475	Manganese, platinum, tungsten.
[2]	------	52,335	1,600	1,962	43,449	Chromite.
				------	47,101	Asbestos, lead, platinum, tungsten concentrates.
[2]	------	72,557	1,400	3,328	116,993	Chromite.
				------	29,884	Asbestos, lead, manganese, platinum, tungsten concentrates.
[2]	------	68,731	1,976	------	12,034	Asbestos, barytes, chromite, copper, granite, lead, platinum.
[2]	------	58,476	6,528	------	17,531	Asbestos, barytes, copper, granite, lead.
------	------	33,906	19,151	------	17,862	Asbestos, barytes, granite.
[2]22,177	$1,015	$901,268	$46,215	------	$814,243	

ORANGE COUNTY,

Year	Petroleum		Natural gas		Brick	
	Barrels	Value	M. cubic feet	Value	M.	Value
1889	----------	----------	----------	----------	----------	----------
1890	----------	----------	----------	----------	----------	----------
1892	----------	----------	----------	----------	----------	----------
1894	----------	----------	----------	----------	----------	----------
1895	----------	----------	----------	----------	----------	----------
1897	12,000	$12,000	----------	----------	----------	----------
1898	60,000	60,000	----------	----------	300	$2,400
1899	108,077	108,077	----------	----------	200	1,600
1900	254,397	254.397	----------	----------	----------	----------
1901	302,652	181,591	----------	----------	----------	----------
1902	1,103,793	824,492	----------	----------	----------	----------
1903	1,355,104	1,016,285	----------	----------	1,634	13,000
1904	1,470,000	1,144,542	----------	----------	1,500	9,000
1905	1,510.900	711,633	----------	----------	118	11,800
1906	2,388,000	1,194,000	----------	----------	1,365	13,500
1907	2,426,750	1,456,050	----------	----------	3,176	26,000
1908	3,376,689	2,532,517	----------	----------	4,050	20,450
1909	4,270,967	2,690,709	----------	----------	4,090	20,650
1910	5,044,001	3,177,721	----------	----------	2,950	31,000
1911	6,345,275	4,097,980	----------	----------	1,650	11,550
1912	6,704,421	4,478,553	71,000	$5,250	1.300	9,100
1913	9,485,362	6,867,402	192,240	9,612	2,100	14,000
1914	12,758,678	8,612,108	1,867,336	112.040	1,333	19,300
1915	12,715,457	6,510,314	1,243,301	81,753	1,280	16,000
1916	13,198,591	8,750,666	2,278,922	139,281	1,186	8,300
1917	14,680,801	14,724,843	8,171,835	490,511	and tile	11,000
1918	15,730,462	22,211,412	10,420,171	693,169	477	3,869
1919	14,458,722	26,893,223	12,039 355	837,439	[2]	----------
1920	15,462,741	33,059,340	10,520,483	862,446	[2]	----------
1921	22,929,466	45,996.509	14,097,639	1,312,704	2,994	47,720
Totals	$168,153,306	$197,566,364	60,902,282	$4,544,205	----------	[2]$290,239

[1] Includes crushed rock, rubble, rip-rap sand, gravel.
[2] See under 'Unapportioned.'

1889-1921.

Pottery clay		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
----------	----------	----------	----------	$6,262	Gold.
----------	----------	----------	----------	10,943	Gold.
----------	----------	----------	----------	9,470	Gold.
----------	----------	----------	1,500 tons	6,000	Coal.
----------	----------	----------	900 tons	4,000	Coal.
			----------	144	Gold.
----------	----------	----------	----------	----------	
----------	----------	----------	800 tons	3,200	Coal.
----------	----------	----------	600 tons	2,400	Coal.
			25 tons	250	Gypsum.
----------	----------	----------	240 cu. ft.	120	Sandstone.
			----------	2,407	Gold.
			500 tons	2,250	Coal.
----------	----------	----------	300 tons	1,500	Coal.
			----------	4,000	Gold.
----------	----------	----------	----------	250	Gold.
----------	----------	----------	----------	150	Gold.
----------	----------	----------	408 cu. ft.	200	Sandstone.
10,500	$14,581	----------	500 cu. ft.	250	Sandstone.
7,740	12,900	----------	----------	----------	
			964 lbs.	193	Copper.
----------	----------	----------	24,472 lbs.	1,303	Lead.
			33,546 lbs.	2,000	Zinc.
9,000	18,600	$3,005	14,405 lbs.	534	Lead.
2,617	26,170	23,665	----------	72,586	Unapportioned, 1900-1909.
500	5,000	6,443	----------	----------	
2,000	3,200	855	----------	----------	
2,100	3,400	21,248	459 tons	688	Glass sand.
15,500	20,666	36,815	----------	----------	
----------	----------	88,315	----------	----------	
			364 lbs.	17	Lead.
----------	----------	9,027	4 lbs.	1	Copper.
----------	----------	3,773	----------	3,066	Other minerals.
[2]	----------	2,699	----------	2,573	Pottery clay, copper, lead.
3,649	4,650	1,560	----------	----------	
			----------	18,499	Clay and clay products.
[2]	----------	1,944	----------	97,632	Lead and potash.
			455 lbs.	84	Copper.
			----------	145	Gold.
[2]	----------	80,988	15,932 lbs.	1,275	Lead.
			----------	7,263	Silver.
			----------	96,595	Brick, clay, potash.
----------	----------	131,301	----------	10,796	Pottery clay, copper, gold, lead, silver.
[2]53,606	$109,167	$412,138	----------	$369,046	

PLACER COUNTY,

Year	Gold, value	Silver, value	Copper		Brick		Pottery clay	
			Pounds	Value	M.	Value	Tons	Value
1880	$838,133	$640	-----	-----	-----	-----	-----	-----
1881	850,000	6,500	-----	-----	-----	-----	-----	-----
1882	800,000	-----	-----	-----	-----	-----	-----	-----
1883	810,000	-----	-----	-----	-----	-----	-----	-----
1884	887,320	5	-----	-----	-----	-----	-----	-----
1885	906,301	-----	-----	-----	-----	-----	-----	-----
1886	1,071,663	1,397	-----	-----	-----	-----	-----	-----
1887	855,510	556	-----	-----	-----	-----	-----	-----
1888	850,000	1,000	-----	-----	-----	-----	-----	-----
1889	1,245,491	1,975	-----	-----	-----	-----	-----	-----
1890	1,003,602	1,045	-----	-----	-----	-----	-----	-----
1891	998,495	5,921	-----	-----	-----	-----	-----	-----
1892	1,159,080	2,120	-----	-----	-----	-----	-----	-----
1893	1,351,250	616	-----	-----	-----	-----	-----	-----
1894	1,851,215	664	-----	-----	-----	-----	22,000	$27,500
1895	1,599,635	5,273	-----	-----	-----	-----	15,000	15.000
1896	1,674,844	6,690	-----	-----	-----	-----	10,000	10,000
1897	1,524.941	6,784	-----	-----	-----	-----	7,500	7,500
1898	1,488,022	5,670	-----	-----	-----	-----	12,000	12,000
1899	1,100,081	1,206	-----	-----	-----	-----	15,000	15,000
1900	986,155	12,058	-----	-----	-----	-----	15,000	15,000
1901	900,745	4,828	11,200	$1,764	-----	-----	15,000	15,000
1902	843,366	3,341	3,200	368	-----	-----	15,000	15,000
1903	570,571	1,116	4,000	520	-----	-----	15,000	15,000
1904	778,355	9,320	600,000	76,500	-----	-----	16,100	16,100
1905	597,793	8,041	367,250	57,291	-----	-----	20,000	10,000
1906	[4]	[4]	200,000	38,600	-----	-----	20,000	15,000
1907	482,772	3,338	-----	-----	-----	-----	20,000	20,000
1908	358,096	2,194	-----	-----	13,000	$46,300	13,000	11,500
1909	281,372	1,492	-----	-----	2,083	52,300	45,300	35,250
1910	257,191	1,157	-----	-----	600	23,438	44,000	27,000
1911	251,298	2,585	118,624	14,828	700	18,000	43,120	29,200
1912	367,383	4,791	78,170	12,898	900	21,250	56,000	41,300
1913	220,785	2,972	429	67	1,900	40,000	63,600	47,200
1914	600,000	4,500	453	60	2,000	40,000	63,700	49,000
1915	414,319	24,543	[4]	-----	2,000	40,000	49,126	37,536
1916	428,400	24,928	1,437,441	353,610	2,540	79,000	29,018	36,230
1917	538,686	13,885	710,601	193,994	[4]	-----	44,097	44,097
1918	230,190	22,432	837,527	206,869	and tile	81,408	29,348	29,348
1919	170,609	3,141	-----	-----	[4]	-----	[4]	-----
1920	151,088	2,178	-----	-----	and tile	149,924	65,560	76,500
1921	132,468	1,068	-----	-----	and tile	144,508	76,665	95,930
Totals	$32,427,225	$201,940	4,368,895	$957,369	-----	[4]$736,128	[4]840,134	$768,191

---

[1] Includes granite (prior to 1916), crushed rock, rubble, rip-rap, paving blocks, sand, gravel.
[2] Barrels of lime.
[3] Tons of limestone.
[4] See under 'Unapportioned.'

1880-1921.

Lime and limestone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	Amount		Amount	Value	Substance
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	$67,200	------------	------------	
------------	------------	56,620	25 tons	$1,000	Asbestos.
------------	------------	44,216	------------	------------	
------------	------------	39,412	------------	------------	
------------	------------	29,833	------------	------------	
------------	------------	61,525	------------	------------	
------------	------------	115,669	------------	------------	
------------	------------	102,847	------------	------------	
------------	------------	156,402	------------	------------	
[2]1,500	$9,000	198,530	------------	280	Platinum.
[3]4,000	4,000		------------	1,968	Quartz.
------------	------------	123,448	------------	375	Platinum
[2]15,533	8,737	116,746	2 ozs.	36	Platinum.
[2]11,699	11,950	71,130	0.66 ozs.	12	Platinum.
			50 tons	2,500	Asbestos.
[2]11,430	11,430	118,722	70 tons	3,500	Asbestos.
[3]38,869	79,768				
[2]1,727	1,710	178,460	50 tons	5,000	Asbestos.
[2]24,322	25,864	203,783	------------	862,362	Unapportioned, 1901-1902.
			60 tons	6,000	Asbestos.
[2]10,000	12,100	242,773	200 tons	20,000	Asbestos.
			125 tons	500	Asbestos.
------------	------------	218,951	300 tons	3,300	Magnesite.
			90 tons	584	Mineral paint
[3]222,595	200,000	231,415	50 tons	500	Magnesite.
			1,000 tons	2,000	Glass sand.
------------	------------	205,749	805 lbs.	35	Lead.
			2,000 tons	4,000	Quartz
[3]202,575	202,575	203,593	385 lbs.	15	Lead.
[3]1,236	2,432	98,187	711 lbs.	33	Lead
			------------	346,810	Asbestos and copper
			744 tons	11,956	Chromite.
[4]	------------	17,026	------------	80,931	Granite.
			------------	10,548	Lead, limestone, magnesite
			4,287 tons	105,384	Chromite.
------------	------------	10,727	------------	30,392	Granite.
			------------	92,624	Asbestos, brick, platinum, tile, gems, magnestie.
			4,963 tons	276,765	Chromite.
------------	------------	4,266	------------	30,882	Granite.
			------------	21,360	Manganese and silica.
			1,018 tons	24,000	Chromite.
------------	------------	4,330	------------	98,513	Clay and clay products
			------------	36,233	Granite.
			------------	1,055	Other minerals.
			300 tons	7,985	Chromite.
------------	------------	6,688	------------	212,625	Granite.
			------------	5,825	Other minerals.
------------	------------	21,490	------------	48,328	Granite.
			------------	5,278	Chromite, mineral paint, silica
------------	[4]$569,566	$2,949,747	------------	$2,361,494	

PLUMAS COUNTY,

Year	Copper		Gold, value	Silver, value
	Pounds	Value		
1880			$857,124	$181
1881			1,350,000	2,000
1882			1,250,000	
1883			950,000	
1884			900,000	
1885			840,308	
1886			834,452	62
1887			698,069	16
1888			650,000	250
1889			796,754	235
1890			490,664	811
1891			482,462	
1892			432,295	11,731
1893			362,488	14
1894			499,359	
1895			602,951	271
1896			462,527	83
1897			339,252	701
1898			369,609	
1899			381,151	15
1900			365,210	4,159
1901			401,287	2,508
1902			380,686	517
1903	1,900	$247	424,112	510
1904			270,439	464
1905	1,006	157	283,810	530
1906			229,350	1,055
1907			219,355	948
1908			254,737	3,560
1909			157,491	587
1910			187,207	1,038
1911			228,785	1,125
1912	6,963	1,149	193,237	957
1913	[3]19,533	3,028	138,368	705
1914	[3]169,089	22,489	140,000	2,900
1915	3,164,496	553,787	167,440	19,025
1916	4,932,928	1,213,500	133,385	46,542
1917	7,462,870	2,037,364	131,955	74,461
1918	11,098,016	2,741,210	125,207	156,750
1919	10,193,951	1,896,075	83,600	175,846
1920	9,583,834	1,763,425	102,097	153,373
1921	11,584,216	1,494,364	127,148	171,090
Totals	58,218,802	$11,726,795	$18,294,371	$835,020

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] See under 'Unapportioned.'

[3] Includes copper erroneously credited to Lassen County in those years, on account of shipping point being Doyle, though the mines were located in Plumas County.

1880-1921.

Manganese		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
1	$10	----	----	----	
2	40	----	----	----	
----	----	----	----	----	
1	25	----	----	----	
----	----	----	----	----	
----	----	----	----	----	
1	30	----	----	$25	Platinum.
1	25	$5,000	----	----	
1	25	----	----	----	
3	75	2,000	----	75,575	Unapportioned, 1900-1909.
5	75	12,500	1,115 lbs.	50	Lead.
2	40	----	1,329 lbs.	60	Lead.
2	40	1,350	5,856 lbs.	264	Lead.
----	----	1,700	5,621 lbs.	247	Lead.
----	----	1,879	2,058 lbs.	80	Lead.
----	----	5,431	----	32	Other minerals.
----	----	1,988	----	3,920	Chromite, granite, molybdenum.
1,540	39,680	1,322	473 tons ----	9,800 304	Chromite. Gems, granite, silica.
1,544	61,754	7,750	----	23	Other minerals.
[2]	----	850	----	1,825	Limestone, manganese.
----	----	62,109	----	2,658	Granite, lead, lime, platinum.
----	----	[2]	2,961 lbs. 18 fine oz. ----	133 1,615 4,111	Lead. Platinum. Granite and miscellaneous stone.
[2]2,103	$101,819	[2]$103,879	----	$100,722	

RIVERSIDE COUNTY
(See page 689)

Year	Gold, value	Silver, value	Platinum		Brick	
			Ounces	Value	M.	Value
1880	$342,514					
1881	425,000	$1,000				
1882	400,000					
1883	480,000					
1884	270,000					
1885	353,522					
1886	280,000					
1887	158,526	176				
1888	150,000					
1889	210,075					
1890	193,585					
1891	142,830	4				
1892	121,900					
1893	90,091					
1894	70.326				11,250	$56,250
1895	145,873				13,125	65,625
1896	133,050				8,700	44,200
1897	93,050				3,100	16,700
1898	57,301				11,000	44,000
1899	115,906				15,600	93,600
1900	176,007	[2]473			8,900	53,400
1901	229,034	[2]253			12,236	62,180
1902	425,894	330			10,492	78,198
1903	335,646	234			15,000	120,000
1904	419,287	75			4,500	20,000
1905	668,382	206	40	$700	18,000	130,000
1906	986,624	3,640	11	200	12,000	108,000
1907	790,973	2,034			16,078	128,624
1908	1,166,055	1,621			7,936	63,491
1909	1,669,814	2,856				
1910	1,396,874	4,606				
1911	1,812,826	3,047			13,017	76,571
1912	1,712,587	3,544			26,073	161,535
1913	2,503,633	3,406			22,535	144,191
1914	2,164,491	3,481	223	7,108	22,862	160,923
1915	2,131,813	3,151	196	6,217	9,920	82,973
1916	1,833,855	3,578	195	8,892	8,924	91,615
1917	1,919,581	4,487	157	12,453	and	tile 122,886
1918	1,694,724	4,637	[3]			79,312
1919	1,714,193	5,276	[3]		[3]	
1920	1,575,033	4,534	[3]			248,433
1921	1,690,662	5,254	[3]			216,402
Totals	$33,251,537	$61,903	[3]822	$35,570		[3]$2,474,109

[1] Includes crushed rock, rubble, rip-rap, sand, gravel, paving blocks.
[2] Recalculated to 'commercial' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] State Prison use, value estimated, as none reported.

COUNTY, 1880-1921.

Granite		Natural gas		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Cubic feet	Value	M. Cubic feet	Value		Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
75,000	[4]$35,000	--------	--------	--------	--------	--------	
85,000	[4]45,000	--------	--------	--------	--------	--------	
--------	--------	--------	--------	$12,018	--------	--------	
207,845	62,339	--------	--------	28,074	--------	$1,500	Pottery clay.
4,840	4,000	15,000	$12,000	14,137	--------	--------	
1,524	1,145	12,000	10,000	13,105	--------	--------	
2,137	3,139	11,750	11,750	14,157	--------	--------	
2,635	2,882	--------	--------	7,926	--------	316	Copper.
288	136	38,550	31,200	19,380	--------	--------	
20,471	2,222	31.680	30,518	18,176	--------	--------	
5,164	4,458	39,200	39,200	22,103	--------	--------	
4,327	1,614	43,564	43,564	32,386	--------	--------	
10,905	1,779	60,225	52,874	18,141	--------	--------	
26,105	4,625	60,225	52,874	13,936	--------	--------	
44,151	44,151	55,000	55,000	151,477	--------	--------	
31,660	23,745	60,000	60,000	235,210	--------	314,438	Unapportioned, 1900-1909
68,684	59,947	49,203	49,203	164,592	--------	--------	
45,630	2,307	90,000	83,890	131,037	--------	--------	
--------	--------	100,000	96,000	197,733	--------	--------	
--------	--------	72,000	36,000	238,476	--------	--------	
--------	--------	80,000	40,000	253,235	--------	--------	
--------	--------	108,000	54,000	284,127	--------	--------	
--------	--------	[3]	--------	194,718	227 lbs.	16	Lead.
					--------	46,000	Pottery clay, natural gas.
--------	--------	[3]	--------	199,839	--------	27,000	Other minerals.
					310 tons	410	Pottery clay.
--------	--------	[3]	--------	262,689	--------	61,235	Natural gas, platinum, potash
--------	--------	[3]	--------	276,732	--------	113,000	Clay and clay products.
					--------	61,395	Natural gas and platinum.
--------	--------	[3]	--------	180,563	--------	57,591	Natural gas, platinum.
--------	39,469	[3]	--------	386,911	--------	56,196	Natural gas, platinum.
636.366	$337,958	[3]926,397	$758,073	$3,370,878	--------	$739,097	

Year	Quicksilver		Lime		Gypsum	
	Flasks	Value	Barrels	Value	Tons	Value
1865	[2]17,455	$943,617				
1866	6,525	346,673				
1867	11,493	527,529				
1868	12,180	559,062				
1869	10,315	473,459				
1870	9,888	567,373				
1871	8,180	516,158				
1872	8,171	538,714				
1873	7,735	621,353				
1874	6,911	726,899				
1875	8,432	709,553				
1876	7,272 [3]2,000	319,968 139,000				
1877	6,316	235,587				
1878	5,138	169,040				
1879	4,425	132,048				
1880	3,209	99,479				
1881	2,775	82,778				
1882	1,953	55,123				
1883	1,606	46,173				
1884	1,025	31.263				
1885	1,144	35,178				
1886	1,406	49,913				
1887	1,890	80,088				
1888	1,320	56,100				
1889	980	44,100				
1890	977	51,293				
1891	792	35,838				
1892	848	34,523				
1893	869	31,936				
1894	1,005	30,861	40,000	$44,000	762	$9,144
1895	1,100	36,000	41,000	41,000	750	8,250
1896	1.335	46,725	40,000	35,000	300	3,000
1897	3,605	135,185	25,000	18,500	300	2,000
1898	5,000	190,000			500	4,500
1899	4,780	245,000	16,600	18,675	100	700
1900	3,990	180,000	7,300	8,800		
1901	4,800	242,300				
1902	7,291	306,081				
1903	8,180	344,251				
1904	[5]8,480	314,000				
1905	7,764	279,651	15,000	15,000		
1906	7,203	262,909				
1907	7,675	292,878	8,453	8,453		
1908	9,600	405,792			2,000	8,000
1909	8,900	440,241			6,000	34,576
1910	10,800	488,700			12,000	50,000
1911	9,775	449,748			10,000	30,625
1912	9,743	409,596			8,000	32,000
1913	9,719	390,995			11,000	35,000
1914	6,633	325,349			7,000	21,000
1915	6,291	475,370				
1916	11,110	1,032,156				
1917	11,150	1,057,770				
1918	10,715	1,234,027				
1919	7,409	668,989				
1920	3,887	296,942				
1921	[6]					
Totals	[6]341,170	$18,841,334	193,353	$189,428	58,712	$238,795

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Production of New Idria Mine from 1858-1866; yearly details not obtainable, though New Idira began operation in 1850.

[3] Estimated output of Cerro Bonito, Monterey and Stayton mines, 1870-1877; yearly details concealed under heading of "various mines" in early reports.

[4] Includes bituminous rock.

[5] Flasks of 75 pounds since June, 1904; 76½ pounds previously

[6] See under 'Unapportioned.'

COUNTY, 1865-1921.

Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value		Amount	Value	Substance
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	58 tons	$2,280	Antimony.
------------	------------	$19,000	------------	------------	
5,000	$300	6,000	2 tons	70	Antimony.
500	100	2,638	------------	------------	
900	450	[4]17,500	45 tons	135	Coal.
1,000	500	[4]25,240	19 tons	380	Asphalt.
10,000	3,750	13,000	100 tons	100	Limestone.
500	125	[4]12,794	------------	------------	
600	150	22,000	------------	------------	
10,000	400	23,200	------------	------------	
------------	------------	16,500	206 tons	2,472	Asphalt.
500	500	64,994	------------	------------	
2,600	3,120	23,000	------------	------------	
26,000	2,600	48,661	------------	------------	
26,000	2,600	63,220	------------	16,500	Gems.
3,120	1,560	83,709	------------	130,000	Unapportioned, 1900-1909.
3,500	1,400	94,243	------------	------------	
3,600	1,540	107,558	------------	------------	
26,000	1,240	83,232	------------	------------	
7,000	4,500	119,500	------------	------------	
700	280	110,630	------------	------------	
1,200	300	155,000	260 M. 2,500 tons ------------	1,560 9,500 335	Brick. Dolomite. Other minerals.
[6]	------------	155,250	8,100 tons ------------	25,515 526	Dolomite. Antimony and mineral water.
[6]	------------	101,148	------------ 7,000 tons	59,245 15,000	Antimony, chromite, magnesite, mineral water. Dolomite.
[6]	------------	103,295	130 tons 5,000 tons 5,340 tons ------------	7,000 20,625 48,060 124,456	Chromite. Dolomite. Magnesite. Cement, manganese, mineral water.
[6]	------------	164,300	7,000 tons ------------	24,500 418,687	Dolomite. Cement, magnesite, mineral water.
[6]	------------	207,250	18,000 tons ------------	57,750 921,082	Dolomite. Cement, magnesite, mineral water.
[6]	------------	269,334	------------	1,116,759	Asbestos, cement, dolomite, magnesite, mineral water, quicksilver.
[6]128,720	$25,415	$2,112,196	------------	$3,002,537	

SAN BERNARDINO COUNTY

(See Page 689)

Year	Gold, value	Silver, value	Brick		Gems, value	Granite, value	Mineral water	
			M.	Value			Gallons	Value
1880	$81,558	---	---	---	---	---	---	---
1881	60,000	---	---	---	---	---	---	---
1882	100,000	---	---	---	---	---	---	---
1883	50,000	5,000	---	---	---	---	---	---
1884	65,000	5,000	---	---	---	---	---	---
1885	95,125	2,000	---	---	---	---	---	---
1886	140,450	78,758	---	---	---	---	---	---
1887	66,900	198,537	---	---	---	---	---	---
1888	160,000	192,000	---	---	---	---	---	---
1889	275,440	25,740	---	---	---	---	---	---
1890	453,800	100	---	---	---	---	---	---
1891	467,000	---	---	---	---	---	---	---
1892	396,518	2,051	---	---	---	---	---	---
1893	105,860	---	---	---	---	---	---	---
1894	266,409	190	---	---	---	---	---	---
1895	344,308	600	---	---	---	---	48,000	11,500
1896	560,578	40	---	---	---	---	45,000	35,000
1897	592,328	---	---	---	---	---	25,000	5,000
1898	673,196	300	672	2,688	---	4,875	4,320	3,000
1899	333,650	---	860	4,300	---	8,150	12,000	6,000
1900	335,937	[2]9,500	734	3,261	500	9,900	6,500	3,250
1901	413,320	[2]2,800	1,158	5,791	20,000	22,400	6,000	3,000
1902	338,877	1,994	688	3,440	150,000	13,175	5,158	1,289
1903	461,516	1,444	2,150	11,150	100,000	16,308	6,000	3,000
1904	334,697	100	3.824	23,700	136,000	7,851	---	---
1905	109,712	100	3,190	28,350	66,000	10,250	---	---
1906	[3]	---	3,950	34,900	284,500	10,250	---	---
1907	7,455	35	4,474	36,430	206,336	23,650	2,000	2,000
1908	6,920	86	2,112	16,719	121,500	10,000	9,810	11,772
1909	12,812	1,721	5,844	38,946	125,000	---	10,210	12,022
1910	[4]	---	8,813	62,647	110,300	---	40,550	30,110
1911	[4]	---	9,500	68,000	25,000	---	60,090	87,020
1912	---	---	10.500	80,000	12,500	---	52,060	17,218
1913	---	---	9,384	68,400	7,465	---	41,500	15,225
1914	---	---	5,457	56.392	1,150	---	8,865	911
1915	1,364	9	1,260	21,025	2,465	---	10,350	1,035
1916	---	---	4,001	36,842	2,710	[3]	[3]	---
			and	tile				
1917	---	[3]	---	21,423	[3]	[3]	[3]	---
1918	---	---	---	29,080	---	[3]	[3]	---
1919	1,470	12	---	[3]	[3]	15,215	[3]	---
1920	---	---	---	87,612	2,100	7,838	---	---
1921	[3]	[3]	---	[3]	1,405	22,444	70,924	9,161
Totals	[3]$7,312,200	[3]$528,117	---	[3]$741,096	[3]$1,374,931	[3]$182,306	[3]604,337	$257,513

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel, paving blocks, grinding-mill pebbles.
[2] Recalculated to 'commercial' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] Included under Imperial County production.

COUNTY, 1880-1921.

Salt		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
700	$5,000	$49,374	50 tons	$2,250	Asbestos.
700	5,000	25,000	----------	----------	
600	4,800	3,573	----------	----------	
650	5,850	23,390	----------	----------	
600	5,000	5,359	----------	----------	
600	5,000	18,198	31,000 lbs.	1,317	Lead.
			124 tons	4,600	Lithia mica.
600	4,000	14,403	440 tons	11,000	Lithia mica.
1,060	9,620	6,887	1,100 tons	27,500	Lithia mica.
7,900	7,900	14,175	822 tons	31,880	Lithia mica.
----------	----------	42,597	700 tons	27,300	Lithia mica.
----------	----------	200,192	641 tons	25,000	Lithia mica.
----------	----------	16,507	4,808 lbs.	750	Copper.
			25 tons	276	Lithia mica.
6,000	5,000	49,738	----------	----------	
7,000	55,000	28,500	13,246 lbs.	2,659	Copper.
			971 lbs.	52	Lead.
			4,000 cu. ft.	12,000	Marble.
7,000	60,000	37,122	----------	----------	
15,000	60,000	33,510	----------	214,634	Unapportioned, 1900-1909.
8,000	24,000	147,817	----------	----------	
13,000	37,500	201,488	----------	----------	
12,450	31,350	164,115	403 tons	500	Pottery clay.
20,500	51,750	170,014	838 tons	2,840	Pottery clay.
15,300	46,200	210,250	30 lbs.	4	Copper.
17,616	19,616	163,723	----------	1,365	Other minerals.
			3,008 lbs.	526	Copper.
			23 lbs.	1	Lead.
[3]	----------	163,925	2,150 tons	175,804	Potash.
			16,806 lbs.	4,134	Copper.
			----------	13,140	Granite, lithia, mineral water, salt.
4,500	9,750	125,855	283 tons	613	Pottery clay.
			153,349 lbs.	43,502	Copper.
			5,252 tons	1,492,123	Potash.
			----------	21,055	Pottery clay, gems, granite, lithia, mineral water, molybdenum, silica, silver.
10,631	61,717	184,158	4,143 lbs.	1,023	Copper.
			700 tons	3,600	Feldspar.
			10,392 tons	1,578,874	Potash.
12,400	52,800	141,996	----------	83,698	Granite, lithia, mineral water.
			----------	62,929	Clay and clay products.
			----------	68,790	Copper, gems, lithia, mineral water, potash, silica.
15,300	77,100	333,847	5,852 tons	57,522	Pottery clay.
			2,953 tons	17,715	Feldspar.
			7,557 tons	18,893	Silica (glass sand).
			----------	191,602	Lithia, magnesium salts, mineral water, tantalum ore (columbite).
[3]	----------	187,922	----------	92,600	Clay and clay products.
			370 tons	725	Glass sand.
			1,850 tons	11,100	Feldspar.
			----------	176,036	Gold, lithia, magnesium salts, marble, salt, silver.
[3]178,107	$643,953	$2,763,635	----------	$4,481,932	

SAN FRANCISCO COUNTY, 1894-1921.

Year	Brick		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	M.	Value		Amount	Value	Substance
1894			$296,864	20 tons	$25	Limestone.
1895			379,696			
1896	5,000	$37,500	285,167			
1897	4,500	28,500	86,217			
1898			129,595			
1899			275,604			
1900			58,400			
1901			156,947			
1902	25,800	238,800	156,300			
1903	33,403	294,326	508,460			
1904	39,509	367,911	332,220			
1905	32,585	310,685	114,357			
1906	7,208	58,289	106,250	8,500 tons	10,500	Glass sand.
1907	44,578	434,140	97,273	4,000 tons	60,000	Asphalt.
1908	41,837	345,155	95,259	1,500 tons	15,000	Asphalt.
1909	31,430	221,332	150,382	850 tons	9,800	Asphalt.
					30,000	Unapportioned, 1900-1909.
1910			108,126	1,000 tons	12,000	Asphaltum.
1911			119,636			
1912			151,147			
1913			110,551			
1914			119,889			
1915			128,270			
1916			76,437			
1917			107,957			
1918			16,463			
1919			65,541			
1920			77,553		2,800	Other minerals.
1921			41,562			
Totals	265,850	$2,336,638	$4,352,213		$140,100	

---

[1] Includes crushed rock, rubble, sand, gravel.

PHYSICAL SCIENCES LIBRARY

RIVERSIDE COUNTY, 1893*-1921.

Year	Gold, value	Silver, value	Coal		Salt		Magnesite		Brick		Pottery clay		Lime and limestone		Miscellaneous stone[1], value	Mineral water	
			Tons	Value	Tons	Value	Tons	Value	M.	Value	Tons	Value	Barrels	Value		Gallons	Value
1891																	
1892																	
1893	$42,412																
1894	93,322		7,891	$16,142	1,981	$3,962					3,700	$4,230	24,000	$19,200	$24,000		
1895	285,106	$2,550	7,950	15,000	4,000	8,000					7,700	9,400	[3]10,000 20,000	10,000 20,000	27,955		
1896	262,800	13,450	4,982	9,964	4,317	8,634					22,019	22,750	[3]6,000 15,000	6,000 15,000	17,000		
1897	147,227	4,000	6,282	15,705	4,840	9,680					11,700	11,250					
1898	189,188	1,384	6,200	15,000	5,000	10,000			560	$5,800	9,500	10,450	8,000	7,000	8,000		
1899	163,010	2,000	7,905	19,762	3,600	7,200			4,750	39,500	14,900	16,800	13,476	13,476	8,850		
1900	149,292	6,848	6,000	15,000	4,000	8,000			1,967	28,842	24,560	18,089			57,600		
1901	109,747	2,150	2,800	7,000	4,000	12,000			3,201	89,787	30,489	16,624	18,000	18,000	53,400		
1902	47,947	94	1,200	3,000	20,000	20,000			4,153	114,165	34,320	38,920	20,000	17,000	92,996		
1903	13,453	136			10,000	20,000			3,817	164,020	53,857	65,332	[3]9,000 25,000	8,500 21,250	152,258		
1904	7,488	80			15,000	15,000			4,712	71,380	41,966	49,232	20,000	20,000	415,306		
1905	35,690	346							2,838	69,195	49,720	67,970	20,000	20,000	360,168		
1906	4,432	251							4,607	92,140	60,123	57,712	14,000	20,000	171,638		
1907	3,836	26					75	$1,750	3,800	102,000	87,260	174,713	6,000	6,500	571,052		
1908	5,884	112					2,000	4,000	4,803	74,086	71,231	89,752	[3]8,000 8,300	8,000 8,300	448,478		
1909	186	24					324	3,888	22,037	265,550	86,028	97,971	3,000	3,000	121,827	30,000	$3,000
1910	5,585	28					500	4,000	10,267	91,543	101,411	156,844	[3]141,722	120,889	116,357	90,000	9,000
1911	[2]20,623	2,121					575	4,600	3,675	28,572	67,295	79,961			474,018	90,580	11,500
1912	20,202	254					878	8,780	2,500	20,000	72,046	93,418	[3]90,831	63,582	567,309	44,256	4,250
1913	12,501	104					569	4,552	3,530	30,300	88,936	89,963			536,844	200,000	20,000
1914	10,000	100							1,610	36,713	70,136	69,420			206,802	100,000	2,000
1915	10,769	1,522							1,055	16,880	59,514	54,840			213,440	200,000	10,000
1916	7,855	338					[4]		1,831	28,593	56,228	56,090			159,555	[4]	
									and	tile							
1917		[4]					[4]			165,892	70,798	55,491			72,364	[4]	
1918	392	1,541					[4]			296,540	48,195	80,454			127,962	[4]	
1919	213	415	[4]				[4]			224,379	42,207	61,006			102,399	[4]	
1920			[4]							489,209	76,317	126,313			296,499	[4]	
1921			[4]							376,553	84,224	111,219			431,671	56,400	2,945
Totals	$1,649,160	[4]$39,874	[4]51,210	$116,573	76,738	$122,476	[4]4,921	$31,570		$2,921,639	1,446,380	$1,786,214		$425,697	$5,835,748	[4]811,236	$62,695

Miscellaneous and unapportioned		
Amount	Value	Substance
125,289 lbs.	$27,564	Tin.
126,000 lbs.	32,400	Tin.
50 tons	100	Gypsum.
18 tons	144	Gypsum.
6 tons	160	Mineral paint.
10 tons	200	Asbestos.
30 tons	750	Asbestos.
1,000 tons	1,500	Glass sand.
50 tons	1,250	Asbestos.
200 tons	200	Glass sand.
110 tons	4,400	Asbestos.
500 tons	500	Glass sand.
300 tons	3,000	Gypsum.
100 tons	500	Gypsum.
12,000 cu. ft.	1,500	Marble.
5,000 cu. ft.	2,500	Marble.
20 tons	2,400	Bismuth.
2,500 cu. ft.	2,500	Marble.
	2,500	Gems.
	2,500	Gems.
3,000 cu. ft.	9,000	Marble.
	50	Gems.
3,206 lbs.	170	Lead.
502 lbs.	100	Copper.
10 tons	100	Asbestos.
22,665 lbs.	2,816	Copper.
3 tons	300	Asbestos.
400 tons	2,000	Gypsum.
8,000 lbs.	1,016	Copper.
	877,192	Unapportioned, 1900-1909.
150 tons	1,500	Mineral paint.
	250	Gems.
	250	Gems.
6,753 lbs.	844	Copper.
800 tons	3,000	Glass sand.
	800	Gems.
929 lbs.	42	Lead.
6,000 lbs.	990	Copper.
	3,532,857	Other minerals, 1910-1912.
1,000 tons	3,000	Gypsum.
	1,000	Gems.
8,971 lbs.	1,391	Copper.
	1,372,314	Other Minerals.
36,102 lbs.	4,802	Copper.
5,350 tons	7,825	Gypsum.
	1,241,924	Other minerals.
3,450 tons	13,650	Gypsum.
	1,022,814	Cement, potash, silica.
32,072 lbs.	1,507	Lead.
23,825 lbs.	4,169	Copper.
58,617 lbs.	14,420	Copper.
8,660 cu. ft.	4,890	Granite.
4,220 tons	8,340	Gypsum.
350 lbs.	24	Lead.
901 tons	1,624	Silica.
	952,505	Cement, feldspar, magnesite, manganese, mineral water, potash.
28,838 lbs.	7,873	Copper.
11,097 tons	422,900	Feldspar.
	3,461	Granite.
1,923 tons	3,001	Gypsum.
1,157 lbs.	100	Lead.
770 tons	2,400	Silica.
	1,227,073	Cement, fluorspar, gems, magnesite, manganese, mineral water, potash, silver.
19,485 lbs.	4,813	Copper.
2,288 tons	11,733	Feldspar.
	3,326	Granite.
3,791 tons	152,693	Manganese.
1,400 tons	4,800	Silica.
	1,004,787	Cement, fluorspar, gems, gypsum, lead, magnesite, mineral water, potash.
10,590 lbs.	1,970	Copper.
	17,975	Granite.
200 tons	425	Gypsum.
1,808 tons	49,324	Manganese ore.
3,034 tons	15,112	Silica.
	2,103,760	Cement, coal, feldspar, fuller's earth, lead, magnesite, mineral water, potash.
1,094 tons	6,168	Feldspar.
	26,408	Granite.
3,195 tons	12,581	Silica.
	4,171,030	Cement, coal, gems, gypsum, mineral water, potash.
2,094 tons	14,808	Feldspar.
	12,852	Granite.
1,625 tons	6,357	Silica.
	3,927,493	Cement, coal, gems, potash.
	$22,012,696	

---

*Riverside County was created March 11, 1893, from portions of San Bernardino and San Diego counties.

[1] Includes granite, crushed rock, gravel, sand, paving blocks.

[2] Includes part of Los Angeles County.

[3] Tons of limestone.

[4] See under 'Unapportioned'.

PHYSICAL SCIENCES LIBRARY

SAN BERNARDINO COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Copper		Lead		Borax, value	Gypsum		Salt		Cement		Lime		Limestone		Brick		Marble		Miscellaneous stone[1], value	Gems, value	Miscellaneous and unapportioned		
			Pounds	Value	Pounds	Value		Tons	Value	Tons	Value	Barrels	Value	Barrels	Value	Tons	Value	M.	Value	Cubic feet	Value			Amount	Value	Substance
1880																										
1881	$9,000	$100,000																								
1882	20,000	150,000																								
1883	30,000	1,050,000																								
1884	32,000	2,550,000																								
1885	23,000	2,363,436																								
1886	56,464	1,204,750																								
1887	27,850	1,133,268																								
1888	25,000	1,200,000																								
1889	10,737	621,820																								
1890	17,335	795,465																								
1891	62,970	711,157																								
1892	47,037	67,072																								
1893	158,000	447,020																								
1894	130,420	148,243					$726,509			1,000	$3,000	8,000	$21,600	40,000	$32,000	5,000	$6,250					$31,622				
1895	131,360	219,410					555,900			3,841	20,101	16,283	32,556	87,864	87,674	30,000	30,000					37,672				
1896	96,723	130,714					650,500			3,000	15,000	9,000	27,000	37,427	34,977	17,500	17,500			500	$3,000	28,476				
1897	100,373	54,407					1,080,000					18,000	66,000	12,000	12,000											
1898	261,512	32,000					1,120,000					50,000	150,000	50,000	35,000	6,600	6,600	2,000	$16,800	1,200	8,000	15,040				
1899	164,599	125,603	1,369,878	$232,339			1,106,000					60,000	180,000	16,000	16,100	16,440	14,810	1,000	8,000	4,500	625	11,275				
1900	247,949	172,759	1,920,000	297,600	10,000	$400	999,340					52,000	121,000	26,261	33,261	7,067	7,067					65,757	$20,000			
1901	399,693	57,164	50,000	7,875	500	20	898,130					71,800	159,842	38,783	43,028	54,210	76,710					166,777	20,000			
1902	394,936	58,972	338,480	41,008	59,340	2,076	2,198,600					96,000	273,600	76,582	65,832	48,986	51,578	60	1,800	6,005	15,600	192,400	11,600			
1903	381,197	59,199	60,400	7,852	14,000	504	495,000					100,000	157,000	39,923	28,692	52,813	64,613	100	8,000	38,000	41,600	266 961	10,000			
1904	595,828	13,025	169,477	17,270										25,000	21,500	28,421	42,575	2,500	17,500	31,116	53,400	158,686		4,000 cu. ft.	$2,000	Sandstone.
1905	473,893	19,595	52,603	8,206										17,024	14,740	27,387	51,395			40,100	40,000	147,197	65,000			
1906	354,830	33,765	514,031	99,207										20,910	17,146	19,837	35,990	1,800	13,500	7,200	25,000	38,476		10 tons	5,500	Tungsten.
1907	158,676	81,339	514,282	102,856	34,211	1,822								8,600	8,600	74,709	139,188	1,665	15,555	6,482	29,946	147,942				
1908	180,511	35,704	516,940	71,079	409,570	17,218		20,000	$70,000	90	650					104,236	97,466	1,050	7,350	150	500	231,242	200			
1909	40,071	12,570	316,300	40,418	310,200	13,254		12,500	43,000	3,500	14,000					22,197	41,395	1,709	11,966	50,000	125,000	173,777	200	300 tons	3,000 4,035,856	Pottery clay. Unapportioned, 1900 1909.
1910	55,093	10,164	5,412	689	134,312	5,972		31,519	70,357	3,000	9,000					224,610	157,715	1,910	11,460			95,126	1,120	430 tons 108,000 gals. 60 tons 100 tons	4,300 25,000 840 1,000	Pottery clay. Mineral water. Barytes. Soapstone.
1911	127,367	35,542	666,489	83,311	161,338	7,260		20,584	66,505	3,600	13,800					245,102	177,080			135	405	167,213		920 tons	4,060	Pottery clay.
1912	293,900	49,962	1,937,185	319,636	94,852	4,268		21,000	67,000	3,600	12,600	[2]2,361,000	2,996,200			80,186	97,867	1,340	8,040			580,824	450	350 tons 200 tons	350 1,200	Pottery clay. Mineral paint.
1913	356,524	44,413	497,852	77,167	279,241	12,287		25,000	74,000	3,049	10,573	[3]		121,544	113,856	25,896	35,464	350	2,100			364,312	550	50 tons 4,500 gals.	550 25,000 1,391,304	Barytes. Mineral water. Other minerals.
1914	205,000	40,000	19,069	2,536	45,110	1,759		17,332	49,150	482	2,892	[3]		84,637	93,100	23,006	20,880	25	1,250			131,978		44,100 gals. 80 tons 140 tons	5,100 561 400 1,240,575	Mineral water. Mineral paint. Glass sand. Other minerals.
1915	416,967	64,165	209,440	36,652	169,183	7,952		[3]		542	3,324	915,000	980,000	[3]		68,500	68,500	400	2,400	[3]		178,528		37,480 gals. 864 tons 39,848 lbs.	7,350 840,947 4,941 62,316	Mineral water. Tungsten concentrates. Zinc. Dolomite, gypsum, lime, manganese, marble, mineral paint, soapstone and talc.
1916	279,813	67,146	1,577,901	388,164	673,801	46,492		[3]		2,355	13,830	1,036,000	1,246,000	151,670	54,317	65,174	63,486	[3]				172,454	1,000	7,500 cu. ft. 40,500 gals. 1,921 tons 707,062 lbs.	2,500 6,500 3,915,434 94,746 217,265	Granite. Mineral water. Tungsten concentrates. Zinc. Brick, dolomite, feldspar, gypsum, manganese, mineral paint, pumice, potash, talc, strontium.
1917	154,976	88,930	1,220,356	333,157	2,293,541	197,245		[3]		[3]		1,323,931	1,672,054	[3]		[3]		[3]				111,158	[3]	235 tons 11,300 gals. 14,570 tons 3,050 tons 1,943 tons 38,735 lbs.	2,350 187,571 6,050 1,620 2,049,120 37,000 2,447,726 3,951 114,834	Granite. Lime and limestone. Manganese. Mineral water. Potash. Strontium. Tungsten concentrates. Zinc. Brick, pottery clay, dolomite, feldspar, gems, gypsum, iron ore, mineral paint, salt, soda, talc.
1918	29,225	88,712	1,580,998	390,507	667,978	47,426		[3]				1,027,635	1,453,962	[3]		10,852	13,323			[3]		48,451	[3]	270 tons 601,500 gals. 27,545 tons 430 tons 2,900 tons 1,347 tons 2,824 lbs.	810 60,150 3,428,443 4,210 33,000 1,911,966 257 122,348	Dolomite. Mineral water. Potash. Talc. Strontium. Tungsten concentrates. Zinc. Gems, granite, gypsum, iron ore, lime, magnesite manganese, marble, mineral paint, salt.
1919	39,769	427,717	256,933	47,790	105,796	5,607	[3]	19,613	50,154			1,078,943	1,717,998	[3]								183,388	[3]	800,060 gals. 21,171 tons 3,601 tons	32,006 1,670,919 19,845 443,492	Mineral water Potash. Talc. Borax, pottery clay, dolomite, gems, lime, tungsten.
1920	79,195	1,212,987	5,386	991	115 876	9,270	440,411	[3]		202	1,220	1,681,283	3,051,079	[3]		[3]						169,991	[3]	95 tons 1,110,190 gals. 15,435 tons	890 156,726 1,082,037 336,551	Pottery clay. Mineral water. Potash. Dolomite, gems, granite, gypsum, iron ore, lime, limestone, soda, talc.
1921	217,568	3,210,706	17,054	2,200	22,812	1,027	338,905	[3]		13,279	67,782	1,964,926	4,633,437	[3]		21,862	106,195					145,572	[3]	683 tons 7 202 tons 2 750 tons	22,980 211,067 43,375 374,726	Calcium chloride. Potash Talc. Pottery clay, dolomite, feldspar, gems, granite, gypsum, iron ore, lime, mineral water, pumice, soda.
Totals	$6,887,361	$18,988,901	13,816,466	$2,308,510	5,601,661	$381,859	[3]$10,609,295	[3]167,548	$490,166	[3]41,540	$187,772	11,869,801	$18,939,328	[3]854,225	$711,823	[3]1,280,591	$1,423,647	[3]15,909	$125,721	[3]185,388	$343,076	$4,062,295	130,120		$26,682,615	

[1] Includes crushed rock, rubble, rip rap, sand, gravel.
[2] Combined annual production 1910, 1911, 1912.
[3] See under 'Unapportioned.'

Year	Brick		Natural gas	
	M.	Value	M. Cubic feet	Value
1885				
1886				
1894				$75,000
1895				100,000
1896	7,000	$35,000		85,157
1897	5,500	22,000		57,411
1898	6,500	34,000		57,289
1899	5,500	27,000	102,960	84,880
1900	2,000	20,000	27,612	19,862
1901	2,000	20,000		60,456
1902	[2]3,000	[2]18,000	81,481	67,868
1903	[2]4,000	[2]24,000	88,134	44,399
1904	7,500	45,000	106,437	47,635
1905	11,400	68,000	100,950	53,915
1906	7,500	49,500	103,450	55,115
1907	12,250	81,000	101,000	52,723
1908	28,412	189,560	60,903	49,194
1909	8,088	242,634	71,883	149,063
1910	8,744	212,538	313,392	159,451
1911	5,275	49,650		114,433
1912	6,128	64,874		145,166
1913	6,314	73,768	142,730	67,967
1914	5,793	82,890	154,872	25,900
1915	3,000	75,000	161,923	143,974
1916	10,189	158,722	182,441	141,605
1917	also	tile 185,060	348,146	72,585
1918		305,475	202,453	60,405
1919		231,478	200,943	76,200
1920		[3]	200,43 3	74,957
1921		294,712	204,057	79,571
Totals		[3]$2,609,861		$2,222,181

---

[1] Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5,000 tons had been produced by that property. Annual amounts earlier than 1894 not separable.

[2] Estimated.

[3] See under 'Unapportioned'.

[4] Includes crushed rock, rubble, rip-rap, sand, gravel.

COUNTY, 1885-1921.

Manganese		Miscellaneous stone[4], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
[1]				$2,500	Gold.
55	$550		275 tons	343	Pottery clay.
280	2,800				
			273 tons	2,730	Asphalt.
			3 tons	90	Infusorial earth.
		25,000			
60	1,080		2,000 tons	13,000	Clay.
				214,835	Unapportioned, 1900-1909.
260	4,160				
			25,510 tons	25,510	Clay.
		900	1,494 tons 3,000 tons	18,522 4,000	Clay. Glass sand.
150	1,500	19,440		200	Other minerals.
460	7,400	21,620		400	Other minerals.
6,493	115,460	53,075			
6,320	157,500	55,003		72	Other minerals.
4,281	117,709	47,085		71,299	Gold, platinum, silver.
343	10,274	59,510		71,538	Gold, platinum, silver.
[3]		63,077		333,068	Brick, gold, manganese, platinum, silver
425	3,750	72,815		23,530	Other minerals.
[3]19,127	$422,183	$417,525	29,835 tons	$781,637	

Year	Bituminous rock		Brick		Chromite		Gold, value	Mineral water	
	Tons	Value	M.	Value	Tons*	Value		Gallons	Value
1876[3]									
1877									
1878									
1879									
1880					[2]17,030	$184,704			
1881					1,790	24,000			
1882							$5,000		
1883					5,558	99,200			
1884									
1885					670	8,880			
1886					980	13,140	9,164		
1887	36,000	$180,000			600	7,980	1,740		
1888	43,000	215,000			300	2,550	3,000		
1889					4,300	66,865	6,260		
1890					687	5,496	8,800		
1891					74	592	1,785		
1892							1,097		
1893							600		
1894	9,432	32,263			[4]800	10,500	1,200		
1895	6,354	17,600	750	$3,750	[4]700	6,650	3,000		
1896	5,113	11,464			[4]200	2,000	3,000		
1897	2,291	5,117					2,500	7,800	$1,960
1898	4,788	18,927	830	5,280			1,000	800	400
1899	10,818	40,288	650	3,500					
1900	3,346	12,905	500	4,000					
1901	9,472	33,070	650	5,200			300	24,000	6,000
1902	1,790	2.327	900	7,650			2,399	4,500	800
1903	3,365	7,572	750	6,000			1,840		
1904							630	4,000	1,000
1905	2,533	6,348	400	3,200			300		
1906	2,533	6,644	300	2,400					
1907	2,167	8,128	2,000	16,000			316	4,800	1,000
1908	5,077	21,875	1,440	12,900				4,800	1,056
1909	2,731	6,369	2,245	19,605				4,000	1,000
1910	1,982	4,016	900	8,000				6,000	1,600
1911	2,710	5,230	2,000	18,000				2,000	1,000
1912	807	1,472						2,500	625
1913	609	1,149	1,750	17,500			124	1,500	600
1914	579	1,118						1,000	250
1915	[6]				[6]			4,500	675
1916	[6]		4,150	45,500	1,855	27,733		2,500	475
1917	[6]		[6]		4,109	92,846		1,500	300
1918	[6]				10,443	539,423	[6]	[6]	
1919	[6]				1,158	26,431			
1920					399	10,440			
1921					[6]			[6]	
Totals	[6]157,497	$638,882	[6]20,215	$178,485	[6]51,653	$1,129,430	[6]$54,055	[6]76,200	$18,741

---

*Copper was weighed in tons of 2,360 pounds and chromite in tons of 2,240 pounds, but here converted to 2,000 pounds.

[1] The total production of asphaltum up to 1894 was reported as 800 barrels. This production reduced to tons is shown under 1894.

[2] Although a great deal of chromic iron ore was mined and marketed during the '70's, there are no records of yearly production. The above figure for 1880 represents the total shipments from San Luis Obispo up to August, 1880.

[3] There are no records of annual mineral production for the period of 1865-1876, but there was a small annual gold production from shallow placers before this, and these placers have no doubt yielded considerable gold never reported. The same observation applies to a number of small quicksilver properties worked in the '70's.

[4] Concentrates.

[5] Includes crushed rock, rubble, sand, gravel; also granite and sandstone prior to 1915

[6] See under 'Unapportioned'.

COUNTY, 1876-1921.

Petroleum		Quicksilver		Miscellaneous stone[5], value	Miscellaneous and unapportioned		
Barrels	Value	Flasks	Value		Amount	Value	Substance
		6,428	$282,832		*236,000 lbs.	$7,287	Copper.
		3,310	123,463				
		2,151	70,768				
		779	2,358				
				$8,772	[1]220 tons 500 cu. ft.	4,400 20,000	Asphaltum (rock). Cal. onyx.
		20	800	45,520	400 cu. ft.	4,000	Cal. onyx.
		101	3,400	17,407			
		101	3,939	13,500	238 cu. ft.	1,000	Cal. onyx.
		384	11,660	47,000			
		394	17,700	6,740	16 tons	320	Asphaltum (rock).
		515	23,886	44,835			
		840	41,513		2,000 tons	30,000	Asphaltum (rock).
		3,312	147,215		4,000 tons	40,000	Asphaltum (rock).
		4,577	183,530	58,374	100 bbls.	100	Lime.
		4,746	176,616	81,000			
		3,733	133,748	46,000			
		3,511	128,152	35,500			
48,127	$16,845	2,509	95,743	3,000	6,000 tons 300 bbls.	90,000 600	Asphaltum (rock). Lime.
10,000	5,000	867	36,648	900			
30,000	15,000	317	15,510	400	4,500 tons	55,000 218,205	Asphaltum (rock). Unapportioned, 1900-1909.
22,310	11,155	563	25,476	75	13,000 tons	165,000	Asphaltum (rock).
38,092	25,146	569	26,180				
2,129	1,469	666	27,998				
		1,160	46,667	134			
		1,266	62,097				
		1,473	125,542	99,475		1,940	Bituminous rock, chromite.
11,670	5,252	1,227	114,724	49,318	356 lbs.	88 2,717	Copper. Bituminous rock, pottery clay, sandstone.
74,143	68,656	1,565	151,034	8,422		16,886	Bituminous rock, brick, manganese, soda.
62,744	56,783	[6]		6,100	1,907 tons	81,926 174,447	Manganese ore. Bituminous rock, copper, gold, mineral water, quicksilver, silver, soda.
31,656	32,922	[6]		20,300		132,777	Bituminous rock, manganese, quicksilver, sandstone, soda.
42,511	59,515	1,224	89,186	[6]		246,463	Copper, granite, manganese, soda, miscellaneous stone.
30,725	43,691			80,000		6,100	Chromite, diatomaceous earth, mineral water.
368,107	$341,434	[6]48,308	$2,168,385	[6]$672,772		$1,299,316	

	Salt		Brick	
	Tons	Value	M.	Value
1895				
1896				
1897				
1898			1,140	$7,000
1899			2,870	24,225
1900			225	9,000
1901	40	$400	500	9,070
1902	6,500	16,000	200	8,000
1903	7,700	25,000	3,100	77,500
1904	12,000	62,500	3,902	56,436
1905	16,000	67,500	5,902	61,436
1906	14,900	44,920	6,613	67,000
1907	14,000	56,000	8,078	86,285
1908	23,800	60,900	4,494	63,231
1909	22,100	95,400	1,346	38,405
1910	26,000	64,750	1,350	37,250
1911	27,500	55,000	1,350	43,000
1912	33,000	80,000	1,400	40,500
1913	28,000	72,250	1,418	44,680
1914	27,500	76,750	950	24,074
1915	25,500	63,750	715	19,550
1916	28,540	70,807	986	38,121
1917	36,483	114,689		
1918	26,434	144,604		
1919	30,238	136,190		
1920	37,409	206,897		
1921	32,587	167,022	[3]	
Totals	476,231	$1,651,329	[3]46,539	$754,763

---

[1] The limestone produced in San Mateo County is used as crushed rock and is included under Stone Industry. Previous to 1915 it was erroneously classified as industrial limestone and tabulated under that heading.

[2] Includes crushed rock, rubble, sand, gravel.

See under 'Unapportioned.'

SANTA BARBARA COUNTY

(See page 699)

COUNTY, 1895-1921.

Limestone		Miscellaneous stone[2], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
----------	----------	----------	5,000 tons	$5,000	Clay.
----------	----------	----------	1,000 bbls.	1,250	Petroleum.
			500 bbls.	1,250	Cement.
----------	----------	$40,000	----------	----------	
----------	----------	70,000	----------	----------	
----------	----------	34,000	----------	----------	
----------	----------	7,500	----------	----------	
----------	----------	6,000	17 tons	255	Asphalt.
----------	----------	301,120	5,000 tons	5,625	Clay.
----------	----------	150,000	----------	----------	
----------	----------	113,866	3,000 bbls.	6,000	Petroleum.
----------	----------	75,000	----------	----------	
----------	----------	111,823	----------	----------	
----------	----------	2,111	----------	----------	
37,687	$17,451	89,142	----------	----------	
120,306	96,245	90,221	----------	500	Gems.
111,382	89,106	88,766	----------	----------	
93,500	74,800	61,185	----------	----------	
102,300	66,495	29,587	----------	----------	
138,544	78,506	18,635	----------	300	Gems.
			81,000 tons	34,120	Sandstone.
153,329	75,941	34,648	6,581 bbls.	845	Lime.
			----------	200	Gems.
[1]	----------	93,391	----------	100	Gems.
			----------	1,100	Other minerals.
----------	----------	25,663	593 tons	732	Pottery clay.
			----------	85	Gems.
----------	----------	71,668	----------	150	Gems.
			----------	20,656	Brick and tile, magnesium chloride, potash.
----------	----------	34,164	----------	15,044	Magnesium chloride, potash.
----------	----------	42,235	----------	63,246	Other minerals.
----------	----------	46,040	322 bbls.	966	Petroleum.
			----------	39,200	Magnesium salts, potash.
----------	----------	61,697	322 bbls.	966	Petroleum.
			----------	27,407	Brick, magnesium chloride, potash.
757,048	$498,544	$1,698,462	----------	$224,897	

SANTA CLARA COUNTY

(See page 699)

Year	Lime		Limestone	
	Barrels	Value	Tons	Value
1894	167,000	$138,200	4,000	$5,000
1895	145,000	133,750	12,055	12,055
1896	116,000	95,500	27,827	28,663
1897	149,600	111,800	10,688	8,005
1898	151,000	151,000	7,912	5,738
1899	161,893	176,893	4,135	3,730
1900	163,985	131,288	1,669	1,213
1901	161,500	161,500	3,845	3,595
1902	185,223	161,302	1,850	1,850
1903	220,835	185,442	3,000	2,725
1904	293,207	306,775	[2]	----------
1905	218,084	199,974	7,325	52,125
1906	255,469	347,490	11,431	55,242
1907	213,599	241,179	6,370	6,000
1908	119,996	119,996	1,178	2,167
1909	228,875	296,785	3,457	5,273
1910	214,137	230,513	4,361	6,770
1911	216,508	206,225	22,622	44,591
1912	169,646	159,505	7,307	7,553
1913	75,000	60,000	39,494	30,994
1914	173,282	157,011	14,666	25,082
1915	191,643	177,873	2,047	4,873
1916	176,263	225,485	4,318	9,820
1917	213.104	173,778	6,527	11,378
1918	182,083	285,316	7,132	15,313
1919	150,271	234,039	5,527	12,690
1920	141,633	202,908	5,062	20,101
1921	122,907	242,869	[2]	----------
Totals	4,977.743	$5,080,437	[2]225,805	$579,785

---

[1] Includes crushed rock, rubble, sand, gravel.

[2] See under 'Unapportioned.'

COUNTY, 1894-1921.

Bituminous rock		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
20,782	$79,980	----------	----------	----------	
32,067	102,486	$4,000	75 M.	$375	Brick.
43,843	109,536	4,000	497 M.	2,485	Brick.
43,179	123,056	----------	300 M.	1,500	Brick.
40,598	113,898	----------	----------	----------	
27,503	70,569	200	----------	----------	
21,960	58,590	----------	----------	----------	
13,580	30,654	----------	10 tons	30	Clay.
31,700	41,084	----------	106 tons	1,060	Asphalt.
18,426	45,190	20,750	700 cu. ft.	140	Granite.
[2]	----------	2,925	----------	----------	
17,583	42,500	1,750	----------	----------	
13,544	38,860	3,500	----------	----------	
21,955	64,707	14,800	----------	----------	
25,041	85,123	19,736	450 cu. ft. 28,400 tons	336 28,400	Granite. Clay.
31,392	110,067	20,717	63,541 tons ----------	13,800 1,794,294	Clay. Unapportioned, 1900-1909.
35,565	124,195	23,425	52,970 tons ----------	15,981 2,096,031	Clay. Unapportioned.
24,815	80,371	7,627	----------	2,448,339	Unapportioned.
32,146	80,439	22,710	----------	879,437	Other Minerals.
26,932	67,330	10,511	----------	1,647,970	Unapportioned.
40,540	115,500	4,276	----------	1,341,089	Unapportioned.
17,399	60,728	6,794	----------	1,331,263	Unapportioned.
[2]	----------	2,815	----------	1,440,991	Cement, marble, bituminous rock.
[2]	----------	2,368	----------	1,480,800	Cement, potash, bituminous rock.
[2]	----------	9,107	----------	2,599,717	Cement, potash, bituminous rock.
[2]	----------	17,074	----------	1,981,253	Other minerals.
[2]	----------	23,379	----------	2,834,750	Bituminous rock, cement, iron ore, mineral paint, potash.
[2]	----------	22,895	----------	3,815,121	Bituminous rock, cement, limestone, mineral paint, potash.
[2]580,550	[2]$2,225,363	$225,359	----------	$25,755,072	

SHASTA COUNTY
(See page 699)

SIERRA COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Miscellaneous and unapportioned		
			Amount	Value	Substance
1880	$974,332	$576			
1881	950,000	6,000			
1882	1,100,000				
1883	1,075,000				
1884	1,177,349	145			
1885	1,433,881	11			
1886	1,967,152	2,414			
1887	1,502,469	202			
1888	1,250,000	1,500			
1889	1,446,486	1,222			
1890	733,528	2,039			
1891	701,702	811			
1892	688,464	26			
1893	839,343	46			
1894	604,722				
1895	694,470	107			
1896	786,175	424			
1897	370,208	46			
1898	399,063	519			
1899	450,115	359			
1900	659,696	3,463			
1901	575,427	755			
1902	326,155	311	24,000 gals.	$6,000	Mineral water.
1903	310,770	476			
1904	374,763	1,222			
1905	517,303	3,687			
1906	409,366	2,518			
1907	483,904	2,621	120,000 gals	12,000	Mineral water.
1908	412 626	1,917			
1909	189,672	957			
1910	312,035	1,330			
1911	461,513	5,604			
1912	732,988	2,777	1,285 lbs.	212	Copper.
			9,919 lbs.	446	Lead.
1913	1,006,573	4,305	2,228 lbs.	98	Lead.
1914	730,000	3,000			
1915	726,362	3,156			
1916	724,256	3,291		1,950	Other minerals.
1917	384,428	1,629	13,031 lbs.	3,558	Copper.
1918	289,368	2,121	807 tons	40,012	Chromite.
1919	301,172	2,957		750	Miscellaneous stone.
1920	442,894	3,967			
1921	612,267	5,236		2,858	Miscellaneous stone.
Totals	$30,127,997	$73,747		$67,884	

SANTA BARBARA COUNTY, 1881-1921.

Year	Petroleum		Natural gas		Asphalt—bituminous rock		Mineral water		Diatomaceous earth		Brick		Limestone		Sandstone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	Barrels	Value	M. Cubic feet	Value	Tons	Value	Gallons	Value	Tons	Value	M.	Value	Tons	Value	Cubic feet	Value		Amount	Value	Substance
1881																			$2,000	Gold.
1882																				
1889																			41,423	Gold.
1890																			10,293	Gold.
1891																			2,478	Gold.
1892																			896	Gold.
1893																				
1894	1,800	$1,800			4,550	$91,000														
1895	16,904	12,678			23,950	139,000	22,500	$3,000											4,000	Gold.
1896	39,792	35,813			18,430	317,910	31,500	20,300							5,000	$500		12 ozs.	44 8,592	Platinum. Gold.
1897	130,136	130,136	[3]500	$246	18,047	318,000	65,000	30,000											3,000	Gold.
1898	132,217	112,549	[3]165	135	19,735	351,400	15,000	7,000			100	$700							1,000	Gold.
1899	208,370	191,228	150	120	6,058	121,160	15,000	5,000			120	960								
1900	183,486	165,138	1,203	2,966	5,270	105,500	19,000	10,350			4,620	40,960	7,205	$3,602	224,820	117,260	$82,662			
1901	203,616	113,385	[3]876	438	4,145	55,800	113,780	60,200			1,250	9,825			72,000	27,100	33,400			
1902	230,440	181,313	937	375	1,259	12,590	105,280	60,200	362	$2,172	1,400	12,200	10,000	25,000	74,200	21,500			200	Gold.
1903	262,226	149,640	320	320	2,974	41,688	88,800	22,280	2,700	15,925	4,900	46,200	20,000	40,000	82,654	34,240	4,395	30,000 bbls.	30,000	Lime.
1904	790,000	445,560	3,000	1,500	9,000	190,000	118,000	18,249	6,950	112,282	1,120	8,420	6,000	12,000	5,000	3,600				
1905	3,534,000	1,413,600			3,000	30,000	115,250	21,450	3,000	15,000	4,025	34,750	5,000	7,500	29,600	18,330	57,792	52 flasks	2,070 725	Quicksilver. Gold.
1906	4,876,000	1,237,250	1,000	500	25,000	250,000	13,750	10,450	2,300	13,800	200	1,600	8,000	16 000	36,195	25,230	9,732		2 250	Silver. Gold.
1907	8,392,623	4,166,661	600	300	19,192	258,549	39,480	24,250	2,531	28,948	1,615	14,650	15,000	30,000	39,740	37,566	4,950	60 flasks	2,289	Quicksilver.
1908	8,847.589	4,423,794	715,612	357,806	7,000	70,000	5,500	4,932	2,950	32,012	750	7,500	16,580	33,160	10,525	6,545	10,930			
1909	8,116,788	4,069,661	768,000	394,621	200	2,488	155,400	22,200			990	9,180	4,849	6,619	31,120	10,648	5,316		89,254	Unapportioned, 1900-1909.
1910	7,682,555	3,856,222	9,198,000	1,393,250			155,000	21,500	1,343	14,117	1,900	16,825	4,028	7,898	39,720	15,888	6,035	70 flasks	3,225	Quicksilver.
1911	6,766,156	3,204.717	[3]1,003,860	100,386			73,640	15,900	1,344	13,720	1,600	13,800	4,239	8,174	58,976	29,507	6,602	50 flasks	2,301	Quicksilver.
1912	6,862,719	3,747,045	[3]3,425,000	253,633	11,120	5 556	105,000	11,550	1,129	13,074	2,615	17,150	5,327	11,666	4,500	1,670	17,480	12,000 tons 17,500 bbls.	16,000 16,434	Clay. Lime.
1913	6,291,076	3,151,725	5,096,300	254,815	10,000	10,000	112,500	108,130	6,895	28,960	3,000	24,000	5,884	19,623	4,500	1,670	11,450	12,000 tons 26,512 bbls.	16,000 25,910	Clay. Lime.
1914	4,325,787	1,989,862	6,313,380	378,802	25.000	50,000	160,400	152,432	[2]		2,100	16,800	6,157	11,263	9,286	1,850	15,300		70,000	Other minerals.
1915	5,634,534	3,442.700	3,193,368	279,697			189,026	156,175			1,800	14,400	5,956	10,006	29,900	6,488	13,900		61,600	Other minerals.
1916	4,502,206	3,574,752	3,660,140	724,746	[2]		176,608	110,200	[2]		[2]		[2]		3,520	1,017	12,395		111,919	Bituminous rock, brick, 'granite,' diatomaceous earth, limestone, quicksilver.
1917	5,631,563	4,550,303	3,104,170	227,507			104,991	86,026	[2]		[2]		[2]		28,700	6,150	5,950	97 tons	126,830 150,315	Potash. Brick, diatomaceous earth, limestone, quicksilver.
1918	7,334,104	9,057,618	4,150,316	338.036	[2]		73,117	97,162	[2]		[2]		3,790	18,830	[2]		11,613	1,863 tons	256,780 271,792	Potash. Bituminous rock, chromite, brick, diatomaceous earth, quicksilver, sandstone.
1919	6,089,082	6,850,217	4,084,709	336,092	[2]		82,147	81,041	[2]		[2]		[2]				29,900	298 tons	30,128 267,539	Potash. Bituminous rock, chromite, brick, diatomaceous earth, limestone.
1920	5,803,583	9,140,643	1,359,665	128,126	[2]		95,843	110,931	[2]		[2]				[2]		27,436	410 tons	40,000 1,091,475	Potash. Bituminous rock, brick, diatomaceous earth, quicksilver, sandstone.
1921	5,465 942	9,122,657	1,544,892	145,179	[2]		97,847	133,590	[2]						[2]		65,600	143 tons	5,720 718,183	Potash. Bituminous rock, diatomaceous earth, sandstone.
Totals	108,355,294	$78,538,667	47,626,163	$5,319,596	[2]213,930	$2,420,641	2,349,359	$1,404,503	[2]31,504	$290,010	[2]34,105	$289,920	[2]128,015	$261,341	[2]789,956	$366,759	$432,839		$3,405,810	

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] See under 'Unapportioned.'
[3] Quantity estimated, as only value originally reported

PHYSICAL SCIENCES LIBRARY

SANTA CLARA COUNTY, 1850-1921.

Year	Quicksilver		Mineral water		Petroleum		Brick		Pottery clay		Sandstone		Limestone		Miscellaneous stone[1], value	Magnesite		Miscellaneous and unapportioned		
	Flasks	Value	Gallons	Value	Barrels	Value	M.	Value	Tons	Value	Cubic feet	Value	Tons	Value		Tons	Value	Amount	Value	Substance
1850	7,723	$768,052																		
1851	27,779	1,859,248																		
1852	15,901	927,505																		
1853	22,284	1,235,648																		
1854	30,004	1,663,722																		
1855	29,142	1,560,554																		
1856	27,138	1,401,678																		
1857	28,204	1,374,381																		
1858	25,761	1,232,149																		
1859	1,294	81,690																		
1860	7,061	378,117																		
1861	34,429	1,447,739																		
1862	39,671	1,442,041																		
1863	32,803	1,380,350																		
1864	42,489	1,950,245																		
1865	47,194	2,166,205																		
1866	35,150	1,867,519																		
1867	24,461	1,122,760																		
1868	25.628	1,176,325																		
1869	16,898	775,618																		
1870	14,423	827,592																		
1871	18,568	1,171,641																		
1872	18,574	1,224,584																		
1873	11,042	887,004																		
1874	9,084	995,455																		
[3]	20,000	1,098,000																		
1875	16,980	1,428,867																		
1876	27,930	1,228,920																		
1877	30,237	1,127,840																		
1878	24,924	820,000																		
1879	36,054	1,076,212																		
1880	30,135	934,185																		
1881	31,288	933,321																		
1882	29,208	824,542																		
1883	29,084	836,165																		
1884	20,000	610,000																		
1885	21,400	658,050																		
1886	18,000	639,000																		
1887	20,000	847,600																		
1888	18,000	765,000																		
1889	13,100	589,500																		
1890	12,000	630,000																		
1891	8,200	371,105																		
1892	5,563	226,470																80,000 cu. ft.	$4,072	Natural gas.
1893	6,614	243,064																		
1894	7,235	222,169	5,000	$1,250	3,500	$8,500	22,725	$119,250			24,000	$8,292						800,000 cu. ft.	12,000	Natural gas.
1895	7,050	253,800	20,000	5,000	4,000	10,000	24,750	131,250							$33,900					
1896	6,222	211,570	44,000	18,800	900	1,145	15,000	80,000					500	$600	5,000				1,300	Natural gas.
1897	4,700	169,200	39,500	17,600	4,000	10,000	19,000	105,000												
1898	5,875	235,000	25,863	11,358	3,000	6,000	13,098	65,490	200	$2,500					12,000			32 tons	640	Asphalt.
1899	4,435	186,270	79,000	19,150	1,500	3,000	30,741	170,455					1,800	3,000	8,000	100	$1,350	5 tons	75	Manganese.
1900	5,145	241,073	30,000	8,060			20,000	136,000	2,000	6,000	120,000	100,000	8,000	6,000		39	253			
1901	5,220	236,608	55,000	8,500			21,800	94,570			60,000	80,000			917	50	300	17 tons	255	Asphalt.
1902	5,869	254,260	21,900	5,500			23,982	178,662			35,000	31,500						2,000 cu. ft.	1,200	Granite.
1903	5,603	233,130	50,000	12,500	4,695	3,966	28,069	188,284			112,350	225,000	7,000	7,000	100			21 tons	47	Bituminous rock.
																		11 tons	132	Asphalt.
1904	3,889	148,103	50,000	12,500	42,000	13,860	24,909	178,581							12,000					
1905	2,693	95,968	5,000	1,200	41,000	14,555	28,486	204,357	700	1,050	100,000	150,000			3,000					
1906	2,592	94,608	5,000	1,250	7,000	2,800	23,397	183,676	1,000	1,500			10,000	15,000						
1907	2,518	96,086	11,374	2,187	22,100	5,525	30,053	255,424			3,500	3,500	9,460	16,694		[4]3,700	33,300			
1908	2,460	103,984	371,635	39,955	35,400	17,700	15,000	63,618					671	1,417	45,142	[4]2,000	24,000	10,017 bbls.	10,017	Lime.
1909	3,747	158,490	373,367	40,754	63,780	76,536	6,000	30,000					2,221	4,150	75,916	300	3,000	1,000 bbls.	1,000	Lime.
																			82,254	Unapportioned, 1900 1909.
1910	4,038	182,719	182,500	11,200	36,660	36,660	12,000	66,000	12,000	66,000			4,284	3,451	68,765	7,560	51,937			
1911	7,533	346,593	165,720	10,000	12,828	8,505	6,000	30,000					2,417	3,918	62,595					
1912	8,695	365,538	152,500	10,250	14,092	8,295	18,000	105,000					3,374	4,120	48,228	600	6,000	13,508 bbls.	10,154	Lime.
1913	3,709	149,213	101,000	10,750	20,000	12,000	18,000	95,000					3,549	4,200	29,377	70	560	13,107 bbls.	9,783	Lime.
																		2,000 cu. ft.	500	Natural gas.
1914	2,407	118,063	29,000	10,750	10,000	5,300	15,900	79,500							39,093	1,425	14,250			
1915	4,386	376,319	38,400	16,770	16,617	11,067	10,096	57,784							98,342	7,623	74,607		340	Other minerals.
1916	4,016	375,496	50,000	11,300	16,368	10,901	13,100	82,800	2,024	2,293			[2]		111,974	23,207	232,156		25,028	Chromite, limestone, manganese.
1917	5,921	639,594	10,230	1,923	18,855	26,152	14,000	80,000	6,014	4,929			[2]		111,304	9,963	99,287		28,341	Chromite, manganese, tile, limestone.
1918	3,977	478,524	13,025	1,678	20,499	34,848	6,792	62,000							111,860	9,746	121,872		948,786	Chromite, manganese, clay, tile, potash.
1919	3,012	271,762	[2]		16,724	26.695	7,250	65,000	2,532	2,232			[2]		73,237	10,912	128,924		480,721	Manganese, limestone, mineral water, potash.
1920	2,893	233,199	3,360	480	16,095	23,901	11,890	164,680	1,900	4,600			[2]		129,582	26,612	392,580		89,670	Limestone and potash.
1921	[2]		2,500	275	13,964	26,943	7,501	110,961	1,126	2,300					138,584	25,800	280,000		191,645	Limestone marl, potash, quicksilver.
Totals	[2]1,151,176	$54,283,002	[2]1,934,874	$290,990	445,577	$404,854	487,539	$3,183,342	29,496	$93,404	454,850	$598,293	[2]51,276	$69,550	$1,218,916	118,797	$1,335,472		$1,880,088	

---

[1] Includes crushed rock, rubble, sand, gravel.
[2] See under 'Unapportioned.'
[3] Estimated production of Guadalupe Mine previous to 1875.
[4] Erroneously credited to Alameda County in reports of those years.

PHYSICAL SCIENCES LIBRARY

PHYSICAL SCIENCES LIBRARY

SHASTA COUNTY, 1880-1921.

Year	Brick		Chromite		Copper		Gold, value	Lime		Limestone		Mineral water		Pyrites		Silver, value	Miscellaneous and unapportioned		
	M.	Value	Tons	Value	Pounds	Value		Barrels	Value	Tons	Value	Gallons	Value	Tons	Value		Amount	Value	Substance
1880							$140,455									$117,907			
1881							350,000									85,000			
1882							300,000									80,000			
1883							210,000									20,000			
1884							320,000									30,000			
1885							417,004									9,223			
1886							699,508									10,647			
1887							627,681									40,204			
1888							600,000									50,000			
1889							415,631									5,396			
1890							420,530									7,279			
1891							554,063									7,432			
1892							574,833									7,977			
1893							500,407									8,577			
1894			1,200	$16,800			617,436					150,000	$75,000			5,032	200 tons	$1,500	Iron ore.
1895			90	1,120			718,696									28,417			
1896	300	$1,500			1,847,087	$184,708	599,209	2,310	$2,541							24,233		1,400	Stone industry.
1897	1,200	7,200			13,592,610	1,535,966	569,071	2,100	2,100	9,000	$13,500					96,869			
1898	1,200	7,200			21,442,000	2,465,830	860,180	2,500	3,750			3,000	2,000			171,768			
1899	2,000	11,000			21,835,863	3,565,023	873,719	8,000	10,000	250	375	5,000	1,850			196,213	100 sq'rs	800	Slate.
																		375	Stone industry.
1900	2,000	12,000	140	1,400	25,736,473	4,166,735	733,467	17,850	17,850	1,150	1,150	9,640	5,784			635,640			
1901	3,000	12,000	130	1,950	30,990,781	4,881,048	927,975	21,600	12,960			26,295	7,644			891,994		2,000	Stone industry.
1902	2,450	12,250	315	4,275	21,515,887	2,496,731	878,706	18,500	12,500	3,500	3,600	26,295	7,645	3,202	$7,005	306,887			
1903	3,500	17,500	150	2,250	16,453,409	2,171,497	771,242	27,000	10,800	5,400	5,400	40,000	12,000	2,500	5,500	203,991		1,500	Stone industry.
1904	3,000	15,000	98	1,470	26,438,145	3,439,974	1,031,429	18,000	10,500							399,660		47,723	Unapportioned, 1900-1909.
1905	3,500	14,000	20	300	10,830,865	1,688,614	684,952	10,700	8,000	3,600	3,600	80,000	12,000			167,548			
1906	4,400	22,000	80	1,200	22,477,304	4,338,121	819,144	12,860	8,040	27,000	32,960			32,689	89,895	434,483			
1907	4,500	33,000	260	5,200	27,844,364	5,568,873	791,997	29,222	31,900	30,761	30,761			65,788	197,364	370,211	400 tons	400	Iron ore.
1908	2 000	12,000	280	5,600	34,878,677	4,642,976	1,131,832	11,818	9,100	80,000	80,000	100,000	20,000	93,677	539,653	517,596		25,000	Stone industry.
1909	3,500	23,500	205	3,517	58,665,447	7,581,115	1,600,489	8,650	8,000	129,560	134,595	100,000	20,000	449,762	1,349,286	735,460	108 tons	174	Iron ore.
																		4,688	Stone industry.
1910	2,425	17,548	680	9,155	44,947,950	5,725,469	1,533,728	16,616	14,114	117,109	117,083	40,000	10,000	31,683	126,692	648,905	579 tons	900	Iron ore.
																	1,859 lbs.	83	Lead.
1911	2,825	20,094	875	13,697	29,539,913	3,692,489	[1]1,059,881	13,271	10,164	67,924	65,253	25,000	6,250	47,885	151,602	386,991	881 lbs.	40	Lead.
1912	1,697	10,195	1,000	8,000	25,249,892	4,166,232	986,803	6,529	3,548	58,022	45,575	23,225	5,646	62,605	174,402	425,382			
1913	360	4,330	280	2,800	27,686,436	4,291,708	1,208,870	8,595	7,030	41,346	35,616	30,000	6,850	72,071	194,409	448,031	47 tons	1,175	Asbestos.
																	19,070 lbs.	839	Lead.
																		10,686	Other minerals.
1914	1,594	10,223	867	4,884	25,122,766	3,341,328	1,101,202	8,657	5,163	36,997	30,026	30,000	6,850	69,438	195,362	346,706	1.436 tons	5,128	Iron ore.
																	21,565 lbs.	841	Lead.
																		125	Miscellaneous stone.
1915	1,836	11,550	1,757	17,570	30,828,917	5,395,060	1,120,848	[2]		44,953	40,945	12,000	1,800	[2]		459,566	180,936 lbs.	8,504	Lead.
																		1,418	Miscellaneous stone.
																	8,378,401 lbs.	1,038,922	Zinc.
																		253,950	Iron ore, pyrites, lime.
1916	[2]		12,425	181,225	39,437,196	9,701,550	936,885	[2]		[2]		[2]		[2]		1,115,471	478,560 lbs.	33,021	Lead.
																		57,303	Lime and limestone.
																	9,484,800 lbs.	1,270,963	Zinc.
																		800	Miscellaneous stone.
																		342,290	Asbestos, brick, iron ore, manganese, mineral water, platinum, pyrites, silica.
1917	[2]		3,116	68,479	28,009,990	7,646,727	775,125	[2]		[2]		[2]		[2]		520,703	8,725 lbs.	750	Lead.
																		78,101	Lime and limestone.
																	14 ozs.	1,100	Platinum.
																		800	Miscellaneous stone.
																	8,281,516 lbs.	844,715	Zinc.
																		308,369	Cadmium, brick, iron ore, mineral water, molybdenum, pyrites, silica.
1918	[2]		1,423	70,214	25,294,590	6,247,764	543,509			45,671	72,410			[2]		420,410	492,565 lbs.	34,972	Lead.
																	35 ozs.	2,709	Platinum.
																		7,000	Miscellaneous stone.
																	3,045,692 lbs.	277,158	Zinc.
																		422,525	Cadmium, brick, iron ore, lime, mineral water molybdenum, pyrites.
1919	[2]				8,673,342	1,613,242	378,283	[2]		[2]		[2]		138,046	497,398	165,802		29,100	Lime and limestone.
																	121 fine ozs	21,075	Platinum.
																		31,750	Miscellaneous stone.
																		40,153	Barytes, brick, iron ore, lead, mineral water, zinc
1920	[2]				810,843	149,195	312,901							135,399	475,330	36,563	64,400 lbs.	5,152	Lead.
																	158 fine ozs.	27,004	Platinum.
																		32,650	Miscellaneous stone.
																		69,743	Asbestos, brick, iron ore, lime, limestone, zinc.
1921					437,593	56,449	267,681	[2]		[2]				[2]		5,581	219 fine ozs.	26,817	Platinum.
																		31,945	Miscellaneous stone.
																		452,589	Asbestos, barytes, iron ore, lead, pyrites, zinc
Totals	[2]47,287	$277,090	25,391	$421,106	620,588,340	$100,754,424	$29,965,372	[2]244,778	$188,060	[2]656,572	$640,439	[2]700,455	$201,319	[2]1,205,645	$4,003,798	$10,645,755		$5,858,725	

---

[1] Dredge production included under Stanislaus County.
[2] See under 'Unapportioned'.

PHYSICAL SCIENCES LIBRARY

SISKIYOU

Year	Gold, value	Silver, value	Chromite		Mineral water	
			Tons	Value	Tons	Value
1880	$440,735	$95,340	----------	----------	----------	----------
1881	850,000	1,500	----------	----------	----------	----------
1882	720,000	----------	----------	----------	----------	----------
1883	400,000	----------	----------	----------	----------	----------
1884	475,000	----------	----------	----------	----------	----------
1885	338,659	----------	----------	----------	----------	----------
1886	342,677	64	----------	----------	----------	----------
1887	606,859	177	----------	----------	----------	----------
1888	625,000	----------	----------	----------	----------	----------
1889	915,294	370	----------	----------	----------	----------
1890	860,303	23	----------	----------	----------	----------
1891	957,220	120	----------	----------	----------	----------
1892	1,013,332	56	----------	----------	----------	----------
1893	799,108	----------	----------	----------	----------	----------
1894	760,782	----------	----------	----------	----------	----------
1895	950,006	177	----------	----------	----------	----------
1896	1,091,265	653	----------	----------	200,000	$80,800
1897	842,123	34	----------	----------	[3]	----------
1898	768,804	321	----------	----------	[3]	----------
1899	991,771	100	----------	----------	[3]	----------
1900	951,397	[2]6,700	----------	----------	[3]	----------
1901	886,043	[2]2,980	----------	----------	700,000	45,000
1902	906,989	233	----------	----------	700,000	175,000
1903	613,576	22	----------	----------	750,000	187,500
1904	892,685	1,230	----------	----------	750,000	50,000
1905	803,035	2,499	----------	----------	750,000	50,000
1906	[3]	[3]	----------	----------	[3]	----------
1907	398,017	3,037	----------	----------	725,000	36,250
1908	504,156	6,125	----------	----------	700,000	80,000
1909	416,160	2,145	----------	----------	500,000	10,000
1910	437,376	2,322	----------	----------	500,000	60,000
1911	422,297	2,561	----------	----------	700,000	120,000
1912	472,314	2,980	220	$2,310	700,000	120,000
1913	[4]180,125	[4]1,228	----------	----------	700 000	120,000
1914	312,842	1,026	----------	----------	650,000	65,000
1915	426,716	2,081	[3]	----------	626,680	62,990
1916	441,307	2,312	2,251	28,731	502,650	50,530
1917	325,550	16,883	2,046	49,797	503,000	50,600
1918	294,227	14,501	6,612	336,588	501,750	50,175
1919	226,525	17,049	510	13,379	451,500	90,375
1920	80,707	5,218	215	5,732	300,150	60,015
1921	42,635	294	[3]	----------	250,150	5,015
Totals	$4,783,617	$192,361	[3]11,854	$436,537	[3]12,160,880	$1,569,250

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Recalculated to 'commercial,' from 'coining value' as originally published.

[3] See under 'Unapportioned.'

[4] Production from dredging operations included in Stanislaus County production.

COUNTY, 1880-1921.

Platinum		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
100	$600	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	$1,202,742	Unapportioned, 1900-1909.
------	------	------	------	------	
------	------	------	200 lbs.	23	Copper.
------	------	------	------	------	
1.6	21	------	------	------	
5.3	93	------	2,500 cu. ft.	1,250	Sandstone.
------	------	------	2,500 cu. ft.	1,500	Sandstone.
------	------	$39,000	193 lbs.	39	Copper.
			2,643 lbs.	140	Lead.
			11,433 cu. ft.	12,897	Sandstone.
			1,000 bbls.	1,000	Lime
			220 tons	300	Limestone.
------	------	------	4,949 lbs.	1,183	Lead.
			1,800 cu. ft.	1,485	Sandstone.
			1,090 lbs.	1,680	Lime.
------	------	5,028	3,360 lbs.	144	Lead.
			50 tons	500	Pumice.
			1,050 cu. ft.	1,750	Sandstone.
			100 bbls.	300	Lime.
			2,225 tons	2,200	Limestone.
------	------	9,475	------	14,745	Gems.
			1,204 cu.ft.	2,000	Sandstone.
			335 bbls.	735	Lime.
			35 tons	525	Limestone.
			------	1,000	Gems.
------	------	6,580	150 bbls.	120	Lime.
			24 tons	24	Limestone.
			650 cu. ft.	455	Sandstone.
			250 cu. ft.	250	Sandstone.
------	------	609	------	250	Gems.
------	------	4,883	------	250	Gems.
			90 tons	2,000	Pumice.
			------	1,500	Other minerals.
9	304	5,371	100 tons	500	Coal.
			58 lbs.	2	Lead.
			677 bbls.	629	Lime.
			250 cu. ft.	150	Sandstone.
------	------	4,630	188 lbs.	9	Lead.
			745 bbls.	745	Lime.
			------	16,923	Chromite, copper, marble, sandstone.
[3]	------	45,407	------	12,609	Copper, building stone, lime, platinum, sandstone.
15	709	134,382	------	500	Granite.
			888,043 lbs.	242,436	Copper.
			192 lbs.	17	Lead.
1	58	24,588	------	8,535	Lime, sandstone, soda.
			573,593 lbs.	141,677	Copper.
			------	15,473	Lead and pumice.
7	1,015	26,405	------	111,294	Copper, limestone, pumice, quicksilver.
------	------	30,322	------	47,121	Copper, lime, limestone, potash, pumice,quicksilver.
[3]	------	44,343	------	1,060	Asbestos, brick, chromite, lime, platinum.
[3]138.9	$2,800	$381,023	------	$1,852,667	

SOLANO COUNTY,

Year	Quicksilver		Mineral water		Lime and limestone	
	Flasks	Value	Gallons	Value	Tons	Value
1873	1,800	$144,594				
1874	1,900	199,842				
1875	2,100	176,715				
1876	1,683	74,052				
1877	1,463	54,570				
1878	802	26,386				
1879	1,290	38,507				
1880	492	15,252				
1881						
1882						
1883						
1884						
1885						
1886						
1887						
1888						
1889						
1890						
1891						
1892						
1893						
1894					6,400	$8,000
1895					4,300	4,635
1896			3,094	$1,547	5,477	5,989
1897					9,608	9,801
1898					6,125	5,570
1899			20,000	4,000		356
1900			20,000	4,000	1,800	1,800
1901			17,800	4,450		5,950
1902	42	1,890	10,000	4,000		
1903	100	4,100	10,000	4,000		
1904	[2]377	15,080	10,000	4,000		
1905	542	18,518	10,000	4,000	100,000	100,000
1906	528	19,272	4,000	4,000		
1907	640	24,422	40,000	4,000		
1908	764	33,294	140,000	11,600		
1909			32,650	5,490		
1910			32,400	3,960		
1911			30,000	4,000		
1912			285,050	44,000		
1913			23,600	3,440		
1914	320	15,696	43,020	5,208	86,128	86,128
1915	[3]		64,200	8,000		
1916	660	61,710	11,200	3,750		
1917	554	52,765	10,960	2,580		
1918	593	59,122	11,440	2,722		
1919	[3]		[3]			
1920	[3]		[3]		[3]	
1921			[3]			
Totals	[3]16,650	$1,035,787	[3]829,324	$132,747	[3]219,838	$228,229

---

[1] Includes crushed rock, rubble, paving blocks, sand, gravel.
[2] Flasks of 75 pounds since June, 1904; 76½ pounds previously.
[3] See under 'Unapportioned.'

1873-1921.

Miscellaneous stone[1], value	Natural gas, value	Miscellaneous and unapportioned		
		Amount	Value	Substance
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
---	---	---	---	
$225	---	---	---	
19,650	---	---	---	
15,752	---	75 tons	$125	Pottery Clay.
20,975	---	400 tons	500	Pottery Clay
15,065	---	---	---	
12,181	---	---	---	
18 900	---	---	---	
2,200	---	---	---	
14,250	---	75,000 bbls.	150 000	Cement.
21,514	---	250,000 bbls.	375,000	Cement.
11,113	---	---	---	
78,573	---	---	---	
143,487	---	---	---	
202,146	$6,584	125 tons	600	Salt.
		3,000 M.	25,000	Brick.
527,319	8,053	400 tons	2,800	Salt.
		1,000 M.	7 000	Brick.
176,813	7,538	100 tons	200	Salt.
		1,600 M.	20,000	Brick.
		5,600 tons	11,200	Clay.
241,949	9,100	50 tons	150	Salt.
181,952	8,596	100 tons	300	Salt.
		500 M.	4,000	Brick.
130,445	8,528	50 tons	100	Salt.
		2,200 M.	20,000	Brick.
28,915	7,366	---	13,570,019	Unapportioned, 1900-1913, inclusive.
71,288	5,546	---	1,500,000	Other minerals.
37,576	[3]	---	1,290,347	Cement, fuller's earth, natural gas, quicksilver, salt.
49,711	[3]	---	1,090,164	Cement, natural gas, salt.
39,826	[3]	---	1,804,060	Cement, fuller's earth, natural gas, salt.
30,124	[3]	---	1,378,758	Cement, fuller's earth, natural gas, onyx, salt.
44,156	[3]	---	1,627,928	Cement, fuller's earth, mineral water, natural gas, quicksilver
[3]	[3]	---	2,930,614	Cement, limestone, onyx, mineral water, natural gas, quicksilver, miscellaneous stone.
60,604	---	---	2,969,594	Cement, mineral water, onyx.
[3]$2,197,109	[3]$61,311	---	$28,778,459	

Year	Quicksilver		Mineral paint		Brick	
	Flasks	Value	Tons	Value	M.	Value
1873	50	$4,017	------	------	------	------
1874	1,700	178,806	------	------	------	------
1875	1,218	102,495	------	------	------	------
1876	3,897	171,468	------	------	------	------
1877	3,609	134,616	------	------	------	------
1878	3,255	106,890	------	------	------	------
1879	2,977	88,923	------	------	------	------
1880	1,445	44,795	------	------	------	------
1881	1,273	37,974	------	------	------	------
1882	2,124	59,960	------	------	------	------
1883	1,669	47,984	------	------	------	------
1884	332	10,126	------	------	------	------
1885	446	13,715	------	------	------	------
1886	735	26,093	------	------	------	------
1887	689	29,196	------	------	1,000	$5,000
1888	1,151	48,918	------	------	1,000	5,000
1889	1,345	60,525	------	------	------	------
1890	1,046	54,915	------	------	------	------
1891	1,660	75,115	------	------	------	------
1892	1,630	66,357	------	------	------	------
1893	1,445	53,104	------	------	------	------
1894	1,368	41,998	100	$3,500	375	1,875
1895	1,813	70,707	225	3,375	350	1,750
1896	1,126	37,150	220	3,740	250	1,250
1897	1,538	59,982	270	3,780	[1]300	1,500
1898	1,704	63,048	------	------	350	2,800
1899	2,119	105,950	------	------	200	1,800
1900	2,209	99,500	------	------	280	2,360
1901	2,130	95,850	------	------	150	1,200
1902	1,440	64,685	30	105	150	1,200
1903	2,404	98,676	800	320	160	1,440
1904	[4]2,700	102,829	------	------	175	1,750
1905	2,504	97,041	------	------	500	4,000
1906	2,070	75,555	------	------	6,800	115,000
1907	560	21,369	------	------	11,600	133,479
1908	590	24,939	------	------	11,000	83,000
1909	344	14,226	------	------	6,500	29,000
1910	260	11,765	------	------	------	------
1911	94	4,325	------	------	------	------
1912	646	27,158	------	------	------	------
1913	12	483	------	------	------	------
1914	13	638	------	------	------	------
1915	159	21,793	------	------	------	------
1916	1,039	97,146	------	------	------	------
1917	2,592	244,810	------	------	------	------
1918	2,417	280,333	------	------	------	------
1919	1,418	119,142	------	------	------	------
1920	[5]	------	------	------	------	------
1921	[5]	------	------	------	------	------
Totals	[5]69,045	$3,297,090	1,645	$ 14,820	41,140	$393,404

[1] Includes crushed rock, rubble, rip-rap, paving blocks, sand, gravel.

[2] Eleventh Census Report, Vol. X, Part 3, p. 605.

[3] Estimated.

[4] Flasks of 75 pounds since June, 1904. Previously 76½ pounds.

[5] See under 'Unapportioned.'

[6] There was a considerable production of paving blocks in Sonoma County in the 70's and '80s, but no available record of annual amounts or values.

1873-1921.

Mineral water		Miscellaneous stone[1], value	Magnesite		Miscellaneous and unapportioned		
Gallons	Value		Tons	Value	Amount	Value	Substance
-----	-----	[5]	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	$350,000	-----	-----	-----	-----	
-----	-----	367,500	-----	-----	-----	-----	
-----	-----	[2]297,236	-----	-----	-----	-----	
-----	-----	[3]245,000	-----	-----	-----	-----	
-----	-----	[3]150,000	-----	-----	-----	-----	
-----	-----	96,000	-----	-----	-----	-----	
-----	-----	92,800	-----	-----	-----	-----	
-----	-----	57,381	-----	-----	-----	-----	
8,000	$32,500	69,508	-----	-----	-----	-----	
14,400	19,287	73,719	-----	-----	-----	-----	
236,000	24,000	33,035	-----	-----	-----	-----	
246,680	23,490	43,371	-----	-----	-----	-----	
21,000	18,500	16,830	-----	-----	-----	-----	
575,000	35,000	20,275	-----	-----	-----	-----	
60,900	17,691	52,701	175	$1,225	64 tons	$4,460	Graphite.
30,000	9,100	121,578	130	455	42 tons	1,680	Graphite.
10,000	4,000	90,933	-----	-----	-----	-----	
11,000	4.400	75,947	-----	-----	1,500 bbls.	2,250	Lime.
10,000	4,000	213,830	-----	-----	-----	-----	
10,000	4,000	158,218	-----	-----	-----	300	Gems.
12,000	4,200	132,946	250	1,250	1,500 bbls. ----- 10,500 tons	2,600 50 10,700	Lime. Gems. Clay.
10,000	1,000	307,695	15	180	2,600 tons	3,000	Clay.
104,000	21,350	319,716	-----	-----	500 tons -----	5,500 15,000	Clay. Unapportioned, 1900-1909.
235,000	50,350	220,998	-----	-----	-----	-----	
202,500	50,250	184,035	-----	-----	-----	1,000	Unapportioned.
62,500	20,950	295,198	300	3,000	-----	-----	
96,240	46,910	191,436	-----	-----	-----	-----	
80,015	46,160	276,516	213	2,130	-----	700	Other minerals.
258,600	41,231	177,917	3,624	34,788	-----	375	Other minerals.
121,366	28,031	232,113	11,653	98,280	243 tons -----	2,478 14,000	Chromite. Building stone, manganese.
121,290	35,031	146,621	5,636	61,335	226 tons 362 tons -----	6,200 12,689 64	Chromite. Manganese. Other minerals.
83,220	36,050	148,347	4,110	40,010	1,540 tons 173 tons -----	73,906 7,645 100	Chromite. Manganese Other minerals.
96,800	22,820	144,014	-----	-----	-----	62	Building stone, curbing
29,928	6,578	217,667	[5]	-----	-----	63,000	Magnesite, quicksilver.
37,641	9,891	151,300	[5]	-----	-----	14,360	Gems, magnesite, quicksilver
2,784,080	$616,770	$5,772,381	[5]25,236	$242,653	-----	$242,119	

STANISLAUS

Year	Gold, value	Silver, value	Brick		Magnesite		Manganese	
			M.	Value	Tons	Value	Tons	Value
1880	$73,271							
1881	63,000	$31,000						
1882	80,000	15,000						
1883	40,000	5,000						
1884	40,000	5,000						
1885	18,660							
1886	47,175							
1887	53,297							
1888	75,000							
1889	20,410							
1890	5,335							
1891	3,000							
1892	14,191							
1893	150							
1894	26,369							
1895	26,482							
1896	16,635							
1897	37,392							
1898	19,400							
1899	10,000							
1900	[1]21,212							
1901	[1]15,700				100	$600		
1902								
1903	[1]52,869	256						
1904	[1]50,000	265						
1905	[1]50,000	240						
1906	[3]	[3]						
1907	3,364	28						
1908	[2]	[2]	750	$7,000				
1909	[2]	[2]	5,000	50,000				
1910	[1]214,187	[1]604	1,500	8,000				
1911	[4]307,538	[4]1,131	850	5,950				
1912	[1]226,163	[1]1,974	250	2,000				
1913	[5]253,166	[5]671	300	2,400				
1914	[2]	[2]	250	2,500				
1915	[3]	[3]						
1916	[3]	[3]	[3]				160	$2,400
1917	[3]	[3]			3,196	44,350	775	26,925
1918	14,196	592			2,024	18,038	5,753	222,422
1919	[3]	[3]			2,031	20,831	8,921	374,584
1920	142,467	775			4,064	39,435	893	12,973
1921	18,439	136			3,378	33,158	[3]	
Totals	[3]$2,139,068	[3]$62,672	[3]8,900	$77,850	14,693	$155,812	[3]16,502	$639,304

---

[1] Includes Merced County.

[2] See Merced County.

[3] See under 'Unapportioned.'

[4] Includes Merced County production; also dredge yield of Shasta and Trinity Counties.

[5] Includes dredge production of Merced and Siskiyou Counties.

COUNTY 1880-1921.

Mineral paint		Miscellaneous stone, value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
105	$2,310				
375	2,800		20 flasks	$800	Quicksilver
17	1,800				
152	1,825				
283	2,898				
204	1,769				
129	193				
200	375		79,330 lbs.	12,494	Copper.
200	350		162,400 lbs.	18,676	Copper.
1,370	2,400		116,000 lbs.	15,080	Copper.
200	1,600		7,300 lbs. 	931 20	Copper. Platinum.
375	2,125				
250	1,720				
250	1,720				
285	2,000	74,000			
285	2,225	225		82,317	Unapportioned, 1900-1909.
40	270				
96	600				
100	600	63,572			
255	1,530	14,482			
52	286	3,096			
[3]		2,250		189,521	Gold, mineral paint, silver, platinum, quicksilver.
507	2,200	17,784		230,638	Chromite, brick, gold, platinum, quicksilver, silvc
[3]		6,240	1,438 tons 	29,240 183,167	Chromite. Gold, mineral paint, platinum, silver.
498	3,088	38,764	1,352 tons 	56,505 308	Chromite. Other minerals.
[3]		28,922		[1]165,989	Gold, mineral paint, platinum, silver.
669	7,062	181,262		1,043	Platinum and quicksilver.
[3]		180,697		3,777	Manganese, mineral paint, platinum, quicksilver.
[3]6,897	$43,746	$611,294		$990,506	

SUTTER COUNTY, 1880-1921.

Year	Amount	Value	Substance
1908	5,000 tons	$5,000	Macadam.
1909			
1916	5,733 tons	6,450	Crushed rock.
1917	4,500 tons	5,000	Crushed rock.
1918			
1919			
1920		54	Other minerals.
1921		54	Other minerals.
Total value		$16,558	

Year	Gold, value	Chromite		Brick	
		Tons	Value	M.	Value
1880 1884	$22,000				
1894		1,680	$12,680		
1895		950	9,025	500	$2,500
1896		56	475		
1897					
1898				200	1,400
1899				300	1,800
1900				325	2,200
1901				300	2,000
1902				500	3,500
1903				600	4,500
1904				500	3,500
1905				650	5,000
1906				700	5,600
1907				400	3,200
1908				400	3,000
1909					
1910				600	3,600
1911					
1912				225	1,300
1913				300	1,800
1914					
1915		[2]		400	2,700
1916		1,896	39,702	[2]	
1917		2,053	41,646		
1918		3,261	152,291		
1919		[2]			
1920					
1921					
Totals	$22,000	[2]9,896	$255,819	[2]6,800	$47,600

[1] Includes crushed rock, rubble, sand, gravel.

[2] See under 'Unapportioned.'

COUNTY, 1880-1921.

Mineral water		Salt, value	Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value			Amount	Value	Substance
----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
10,000	$2,400	----------	----------	----------	----------	
54,000	8,000	----------	----------	----------	----------	
10,000	18,000	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
20,000	4,000	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
5,000	2,500	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
8,000	4,000	----------	----------	----------	----------	
8,000	4,000	----------	----------	----------	----------	
550,000	55,000	----------	----------	----------	----------	
20,000	2,000	300	----------	----------	----------	
5,000	500	300	----------	----------	----------	
5,000	500	300	----------	----------	----------	
5,000	500	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	
75	42	----------	$600	----------	----------	
100	100	200	----------	----------	----------	
1,000	500	[2]	750	----------	$752	Chromite and salt.
[2]	----------	----------	11,076	----------	3,575	Brick, granite, mineral water, natural gas.
----------	----------	----------	2,373		----------	
----------	----------	----------	2,500	----------	2,800	Other minerals.
----------	----------	----------	7,500	----------	1,500	Other minerals.
----------	----------	----------	[2]	----------	26,400	Unapportioned.
----------	----------	----------	30,520	----------	300	Other animals.
[2]701,175	$102,042	[2]$1,100	[2]$55,319	----------	$35,327	

TRINITY

Year	Gold, value	Silver, value	Quicksilver	
			Flasks	Value
Altoona Mine, before 1875 (est.)*	[5]	[5]	1,000	$88,000
1875			1,500	126,425
1876			1,979	87,076
1877			1,317	49,129
1878			1,534	50,469
1879			1,919	57,282
1880	$326,693	$142	245	7,595
1881	550,000	1,500		
1882	600,000			
1883	400,000			
1884	529,150	[2]334		
1885	338,148	10		
1886	464,726	219		
1887	553,051	924		
1888	589,000	500		
1889	811,632	640		
1890	1,192,790	259	240	12,600
1891	1,327,787	2,249		
1892	1,446,603	168		
1893	1,122,995			
1894	1,012,666	325		
1895	1,166,745	1,257	3,926	137,410
1896	1,296,330		4,205	139,035
1897	1,078,372	259	838	29,330
1898	859,255	314	4,032	151,200
1899	590,510	1,086	3,076	123,624
1900	571,605	[3]7,935	2,294	105,982
1901	684,683	[3]1,240	1,302	58,668
1902	719,992	550	240	10,251
1903	607,728	2,085	266	11,156
1904	574,814	135	102	3,864
1905	690,844	3,044	389	13,917
1906	560,843	2,981	166	6,059
1907	535,316	2,399	98	3,739
1908	602,944	4,269	90	3,808
1909	520,046	2,302	197	7,915
1910	500,851	1,960	133	5,622
1911	612,149	6,777	44	2,024
1912	723,503	7,494	18	758
1913	431,862	2,119	4	161
1914	743,512	3,374		
1915	441,846	3,470	[4]	
1916	435,493	7,591	[4]	
1917	602,048	10,021	[4]	
1918	444,729	6,912	[4]	
1919	538,494	3,872	[4]	
1920	541,387	3,469	[4]	
1921	437,993	1,390		
Totals	$28,779,135	$95,575	[4]31,154	$1,293,099

---

*Bradley, W. W., Quicksilver resources of California; Cal. State Min. Bur., Bull. 78, p. 200, 1918.

[1] Includes crushed rock, rubble, sand, gravel.

[2] Lawver, A. M., in 'Production of Precious Metals in U. S.'; Report of Director of Mint, 1884, p. 175, 1885.

[3] Recalculated to 'commercial' from 'coining value' as originally published.

[4] See under 'Unapportioned.'

[5] The metal contained in the 1919 product was 38% iridium and 62% platinum.

[6] No county segregated figures for gold and silver available for years earlier than 1880.

COUNTY, 1875-1921.

Platinum		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	3,620 cu. ft.	$5,000	Granite.
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	-----------	-----------	
-----------	-----------	-----------	500 cu. ft.	375	Granite.
-----------	-----------	-----------	5,750 cu. ft.	4,535	Granite.
-----------	-----------	-----------	4,838 lbs. 6,870 cu. ft.	761 5,500	Copper. Granite.
39	$468	-----------	-----------	-----------	
13	200	-----------	100 cu. ft.	75	Granite.
11	275	-----------	-----------	-----------	
26	450	-----------	-----------	-----------	
7	130	-----------	-----------	-----------	
[4]	-----------	-----------	-----------	-----------	
[4]	-----------	-----------	-----------	-----------	
[4]	-----------	-----------	-----------	111,307	Unapportioned, 1900-1909.
[4]	-----------	-----------	-----------	-----------	
[4]	-----------	-----------	-----------	-----------	
[4]	-----------	$2,000	-----------	-----------	
[4]	-----------	1,000	-----------	-----------	
5	151	-----------	-----------	245	Mineral water.
13	435	900	120 gals. -----------	360 52,500	Mineral water. Other minerals.
113	5,161	1,000	-----------	397,316	Chromite, copper, manganese, mineral water, quicksilver.
50	3,283	7,718	242 tons -----------	6,325 358,447	Chromite. Copper, manganese, mineral water, quicksilver.
41	3,136	1,513	1,814 tons -----------	75,660 175,574	Chromite. Copper, mineral water, quicksilver.
[4] [5] fine ounces	-----------	11,839	-----------	17,444	Copper, mineral water, platinum, quicksilver.
37	6,612	8,799	-----------	1,838	Other minerals.
27	3,260	[4]	-----------	14,239	Quicksilver, miscellaneous stone.
[4]382	$23,561	[4]$34,769	-----------	$1,232,501	

Year	Gold, value	Silver, value	Brick		Gems, value	Granite	
			M.	Value		Cubic feet	Value
1880	$1,125	$526					
1881	8,181	36					
1882	5,000	2,000					
1883	4,000	1,000					
1884	70,000						
1885	7,500						
1886	6,900	50					
1887	15,640	167					
1888	25,000						
1889	39,340	250					
1890	43,019						
1891	15,095						
1892	24,355	11					
1893	12,818						
1894						4,668	$10,000
1895	16,320					3,000	2,500
1896	20,092					2,800	4,700
1897	12,830	214				3,600	8,000
1898	12,400		300	$2,000		700	1,500
1899	13,610		600	4,200		1,200	3000
1900	10,445	433	650	6,100		1,500	3,000
1901	14,616	100	1,600	8,600		9,000	18,000
1902	11,648		4,500	27,000	$500	1,790	4,000
1903	9,215		1,500	9,500	500	3,000	2,260
1904	1,100		1,250	10,000		7,000	16,000
1905	2,300	13	2,000	16,000	5,000	7,000	9,000
1906	20		1,500	12,000	209,790	7,000	9,000
1907			2,500	20,000	26.206		
1908			2,250	18,000	62,250		
1909			6,620	42,400	58,000		
1910			8,195	64,000	104,000	700	1,500
1911			10,225	81,000	20,000		
1912			10,900	70,500	5,350		
1913			6,000	45,000	1,500		
1914			6,838	47,507			
1915			5,520	33,364			
1916			6,330	48,500			[2]
1917			6,771	112,938			[2]
1918			[2]		[2]		[2]
1919			and tile	34,978			[2]
1920			[2]				[2]
1921			[2]				[2]
Totals	$402,569	$4,800		[2]$713,587	[2]$493,096		[2]$92,460

---

[1] Includes crushed rock, rubble, sand, gravel.

[2] See under 'Unapportioned.'

COUNTY, 1880-1921.

Magnesite		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
------------	------------	------------	80 tons	$960	Limestone.
------------	------------	------------	1,000 bbls.	1,500	Lime.
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
200	$1,500	------------	22 tons	88	Gypsum.
3,511	28,210	------------	------------	------------	
2,450	19,250	------------	------------	------------	
1,300	19,600	$100	------------	------------	
2,800	9,100	------------	------------	50,108	Unapportioned, 1900-1909.
------------	------------	------------	------------	------------	
------------	------------	------------	------------	------------	
2,380	21,420	------------	400 tons	2,200	Gypsum.
6,567	52,642	------------	------------	------------	
6,468	47,200	------------	2,803 lbs. ------------	360 185	Copper Natural gas.
7,110	35,550	------------	2,000 M.cu.ft	1,000	Natural gas.
7,763	57,335	------------	------------	------------	
6,684	66,840	------------	100 cu. ft.	200	Marble.
7,858	62,864	4,350	80 tons 392 cu. ft. 1,429 tons	200 796 5,050	Quartz. Marble. Feldspar.
9,650	96,500	1,750	1,250 tons 2,830 tons 6 cu. ft.	2,400 13,065 30	Quartz. Feldspar. Marble.
11,574	104,166	36,851	1,349 tons 1,800 tons ------------	1,888 6,500 1,830	Limestone. Feldspar. Chromite and silica.
87,606	737,130	82,255	3,435 tons 1,422 lbs. ------------	42,555 350 36,410	Chromite. Copper. Feldspar, granite, limestone, marble, silica.
136,562	1,238,853	75,594	450 tons 240 tons ------------	11,000 1,580 60,023	Chromite. Feldspar. Building, tile, copper, graphite, limestone, talc.
28,826	269,748	125,407	600 tons 444 tons 8,400 tons 204 tons ------------	24,000 2,928 32,400 1,143 71,782	Chromite. Feldspar. Limestone. Silica. Brick, gems, granite, soapstone, talc, tile.
18,765	186,601	10,811	10,347 tons 700M. cu. ft. ------------	46,388 295 51,928	Limestone. Natural gas. Chromite, feldspar, granite.
35,305	394,169	8,465	400M. cu. ft. ------------	195 190,467	Natural gas. Brick, feldspar, granite, limestone.
11,454	125,594	284,122	10,030 tons 380M. cu. ft. ------------	40,090 190 102,238	Limestone. Natural gas. Brick and granite.
394,833	$3,574,272	$629,705	------------	$804,322	

TUOLUMNE

Year	Gold, value	Silver, value	Lime		Limestone	
			Barrels	Value	Tons	Value
1880	$461,861	$1,071				
1881	500,000	1,000				
1882	400,000					
1883	320,000					
1884	310,000					
1885	320,903	1,473				
1886	432,438	1,551				
1887	504,662	3,166				
1888	475,000	3,500				
1889	446,300	543				
1890	1,500,629	13,062				
1891	1,384,950	139				
1892	1,092,549	911				
1893	354,734	1,329				
1894	547,448	1,072				
1895	666,754	313				
1896	1,070,141	328				
1897	1,809,572	1,696				
1898	1,734,953	15,582				
1899	1,635,769	15,111				
1900	1,596,891	62,367				
1901	1,670,368	39,787				
1902	1,791,829	6,580				
1903	1,732,572	13,989	1,600	$1,600		
1904	1,563,907	12,963				
1905	1,291,726	21.348	500	1,000		
1906	1,039,675	8,476	500	1,000		
1907	806,875	6,453	110,000	125,000		
1908	798,752	11,732	60,000	69,500	1,233	$6,500
1909	925,703	4,384	60,000	60,000	15,057	28,942
1910	615,626	5,754	78,300	78,300	3,600	10,400
1911	1,093,484	13,243	75,000	70,000	4,319	13,609
1912	1,113,291	25,146	117,450	121,250	11,554	20,099
1913	974,409	24,381	75,000	85,000	12,446	20,676
1914	940,793	12,017	63,331	38,000	16,707	21,907
1915	1,058,103	13,480	[2]		8,859	11 349
1916	868,237	17,039	[2]		3,137	5,132
1917	321,085	7,808	[2]		3,287	6,481
1918	274,328	21,425	[2]		3,064	5,600
1919	471,021	11,076	[2]		[2]	
1920	254,569	6,007	[2]		7,494	15,288
1921	96,026	2,505	[2]		3,650	9,475
Totals	$37,267,933	$409,807	[2]641,681	$650,650	[2]94,407	$185,458

COUNTY, 1880-1921.

Marble		Copper		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Cubic feet	Value	Pounds	Value		Amount	Value	Substance
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	800 M.	$2,288	Brick.
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	1,301	Unapportioned, 1900-1909.
-----	-----	-----	-----	-----	400 lbs.	16	Lead.
7,000	$14,000	155,826	$17,920	-----	-----	-----	
11,550	28,875	-----	-----	-----	10,367 cu. ft.	14,020	Granite.
11,500	28,750	-----	-----	-----	9,700 cu. ft.	9,700	Granite.
11,000	66,000	-----	-----	-----	9,700 cu. ft.	9,700	Granite.
23,000	46 000	-----	-----	-----	9,700 cu. ft.	9,700	Granite.
					197 tons	1,379	Chromite.
22,030	60,120	-----	-----	-----	-----	-----	
18,503	47,165	-----	-----	-----	-----	-----	
27,600	107,400	9,086	1,154	-----	30 tons	180	Chromite.
17,360	45,400	-----	-----	-----	2,502 lbs.	111	Lead
18,966	50,398	-----	-----	-----	-----	-----	
27,720	73,920	-----	-----	-----	-----	-----	
37,312	93,726	893	138	-----	893 lbs.	53	Lead.
21,830	38,202	45	6	-----	89 lbs.	3	Lead.
[2]	-----	27,667	4.842	$1,900	352 tons	2,352	Chromite.
					1,779 lbs.	84	Lead.
					-----	79,328	Dolomite, lime, marble.
[2]	-----	1,797	442	1,500	285 tons	4,556	Chromite.
					873 lbs.	60	Lead.
					-----	107,296	Dolomite, lime, magnesite, marble.
[2]	-----	32,840	8,960	3,800	2,680 tons	54,290	Chromite.
					997 lbs.	86	Lead.
					-----	108,758	Dolomite, lime, magnesite, marble.
[2]	-----	35,127	8,676	1,700	4,269 tons	168.693	Chromite.
					-----	121,806	Lime, manganese, marble.
[2]	-----	[2]	-----	2,700	-----	110,746	Lime and limestone.
					-----	78,950	Chromite, copper, granite, marble.
[2]	-----	-----	-----	28,696	-----	209,354	Dolomite, lime, marble, platinum.
[2]	-----	-----	-----	229,185	-----	217,292	Dolomite, granite, lime, marble.
[2]255,371	$699,756	[2]263,281	$42,143	$269,481	-----	$1,312,152	

VENTURA

Year	Gold, value	Petroleum		Natural gas		Asphalt and bituminous brick		Brick	
		Barrels	Value	M. cu. ft.	Value	Tons	Value	M	Value
1880	$354	[2]							
1881	600								
1882									
1883									
1884									
1885									
1886									
1887									
1888									
1889									
1890	2,468								
1891	1,715								
1892									
1893									
1894		290,913	$367,822			248	$4,800		
1895		244,624	244,624			175	3,500		
1896		248,000	272,800						
1897		368,282	368,282						
1898		427,000	571,000			4,105	80,775	286	$2,228
1899	3,990	496,200	496,200			5,188	103,760	375	3,000
1900	2,562	443,000	398,700			1,466	31,670	230	1,700
1901	4,183	472,057	236,028			2,073	30,945		
1902	2,012	475,000	455,000			37	370		
1903	1,087	542,902	517,611			1,114	13,368	1,380	12,900
1904	2,700	518,000	465,682	1,800	$2,700	3,169	38,028		
1905	1,200	375,522	236,578	3,831	5,000	3,000	30,000	1,300	10,400
1906	[3]	311,000	155,500	3,500	1,000	3,700	37,000	1,675	11,650
1907		352,224	211,334	1,825	2,278			1,600	12,800
1908		289,625	217,219	3,625	4,531			200	1,500
1909		344,419	223,872	1,721	2.151			1,275	7,625
1910		492,147	319,898	545	681			1,190	36,945
1911		499,082	349,777	[4]29,580	2,958			900	5,100
1912		662,300	584,811	[4]55,068	4,163			550	3,575
1913		899,007	907,997	62,200	6,220			1,023	6,085
1914		943,929	991,125	100,000	6,000			449	3,102
1915		1,017,220	869,723	491,879	29,670			200	2,500
1916		943,499	985,956	806,540	133,867			[3]	
1917		996.501	1,313,388	1,033,564	152,550			[3]	
1918		1,339,342	1,982,226	858,457	150,885				
1919		1,685,073	2,755,094	1,038,574	252,240			[3]	
1920		1,989,681	4,988,130	1,521,448	214,280				
1921		2,167,326	5,869,119	2,127,476	360,443			[3]	
Totals	[3]$22,871	19,833,875	$27,355,496	8,141,633	$1,331,617	24,275	$374,216	[3]12,643	$121,170

---

[1] Includes crushed rock, rubble, sand, gravel.

[2] Commercial production of petroleum in Ventura County began at least as early as 1874, in the Sulphur Mountain district, but detailed county segregations are not available for the early years.

[3] See under 'Unapportioned.'

Quantity estimated, as only values given in reports of those years.

COUNTY, 1880-1921.

Pottery clay		Sandstone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value	Cubic feet	Value		Amount	Value	Substance
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	16,200	$16,500	-----	-----	-----	
-----	-----	33,200	20,000	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	250 tons	$6,500	Borax.
-----	-----	12,500	6,250	$35,279	-----	-----	
-----	-----	4,200	2,650	16,764	3,000 tons	60,000	Borax.
					-----	4	Silver.
-----	-----	3,200	1,600	22,500	50 tons	2,500	Mica.
-----	-----	1,750	900	25,100	3,500 tons	140,000	Borax.
					50 tons	3,800	Mica.
-----	-----	6,000	3,500	31,227	50 tons	3,000	Mica.
30	$45	2,300	1,380	60,490	-----	-----	
-----	-----	1,320	792	-----	-----	-----	
-----	-----	-----	-----	20,880	-----	-----	
560	1,680	-----	-----	15,406	-----	-----	
-----	-----	-----	-----	144,226	-----	830,853	Unappropriated, 1900-1909.
-----	-----	900	450	35,000	-----	-----	
1,900	1,900	4,658	2,325	750	-----	-----	
1,000	1,000	4,600	1,850	-----	-----	-----	
3,000	2,990	300	150	-----	-----	1,530	Unapportioned.
-----	-----	1,195	502	-----	-----	-----	
-----	-----	-----	-----	2,674	-----	200	Other minerals.
[3]	-----	[3]	-----	14,200	-----	1,407	Brick, clay, sandstone.
[3]	-----	[3]	-----	30,000	-----	2,072	Brick and sandstone.
-----	-----	[3]	-----	52,900	-----	300	Other minerals.
[3]	-----	[3]	-----	5,000	-----	4,500	Clay and clay products.
					-----	190	Other minerals.
[3]	-----	[3]	-----	26,265	-----	500	Mineral paint and sandstone.
-----	-----	-----	-----	11,250	-----	3,985	Clay and clay products.
					-----	472	Mineral paint and sandstone.
[3]6,490	$7,615	[3]92,343	$58,849	$549,911	-----	$1,061,813	

YOLO COUNTY, 1873-1921.

Year	Quicksilver		Sandstone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	Flasks	Value	Cubic feet	Value		Amount	Value	Substance
1873	[2]995	$79,928						
1874	3,000	315,540						
1875								
1876	965	42,460						
1877	1,516	56,547						
1878	1,640	53,956						
1879	1,110	33,134						
1880	422	13,082						
1881								
1894			2,500	$1,000				
1895			542	1,873				
1896			252	378				
1897								
1898			264	384				
1899			264	384				
1900			908	1,760				
1901			1,540	2,300				
1902			328	450				
1903			280	144				
1904			180	720				
1905			175	200				
1906			160	204				
1907			250	350				
1908			140	1,150				
1909								
1910								
1911								
1912								
1913								
1914	15	736						
1915	[3]				$1,200		$840	Other minerals.
1916					300			
1917	[3]				4,300		1,261	Other minerals.
1918	[3]				17,915		3,300	Other minerals.
1919	[3]				5,600		19,866	Other minerals.
1920					9,472			
1921					14,829			
Totals	[3]9,663	$595,383	7,783	$11,297	$53,616		$25,267	

[1] Includes crushed rock, sand, gravel.
[2] Flasks of 76½ pounds, previous to June, 1904; of 75 pounds since.
[3] See under 'Unapportioned.'

YUBA COUNTY, 1880-1921.

Year	Gold, value	Silver, value	Platinum		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Ounces	Value		Amount	Value	Substance
1880	$943,860	$438	--------	--------	--------	--------	--------	
1881	800,000	1,300	--------	--------	--------	--------	--------	
1882	750,000	--------	--------	--------	--------	--------	--------	
1883	455,000	--------	--------	--------	--------	--------	--------	
1884	250,000	--------	--------	--------	--------	--------	--------	
1885	207,449	--------	--------	--------	--------	--------	--------	
1886	149,203	--------	--------	--------	--------	--------	--------	
1887	162,426	--------	--------	--------	--------	--------	--------	
1888	150,000	--------	--------	--------	--------	--------	--------	
1889	112,053	115	--------	--------	--------	--------	--------	
1890	141,781	--------	--------	--------	--------	--------	--------	
1891	37,576	--------	--------	--------	--------	--------	--------	
1892	44,218	--------	--------	--------	--------	--------	--------	
1893	30,839	--------	--------	--------	--------	--------	--------	
1894	107,480	--------	--------	--------	--------	--------	--------	
1895	111,482	--------	--------	--------	--------	--------	--------	
1896	171,688	--------	--------	--------	--------	--------	--------	
1897	141,638	--------	--------	--------	--------	--------	--------	
1898	166,865	--------	--------	--------	--------	--------	--------	
1899	189,927	12	--------	--------	--------	--------	--------	
1900	280,366	[2]2,041	--------	--------	--------	--------	--------	
1901	188,908	[2]393	--------	--------	--------	--------	--------	
1902	155,630	2	--------	--------	--------	--------	--------	
1903	125,830	41	--------	--------	--------	--------	--------	
1904	139,528	--------	--------	--------	--------	400 M.	$3,000	Brick.
						375 tons	750	Pottery clay.
1905	324,135	369	--------	--------	--------	400 tons	80	Pottery clay.
						2.000 gals.	800	Mineral water
1906	[3]	[3]	--------	--------	--------	2,000 gals.	800	Mineral water.
1907	1,766,770	6,167	--------	--------	--------	1,800 gals.	720	Mineral water
1908	2,034,486	9,997	--------	--------	$5,750	1,000 M.	10,000	Brick.
1909	2,469,865	4,156	--------	--------	5,650	550 M.	6,600	Brick.
						--------	568,564	Unapportioned 1900-1909
1910	3 204,273	5,372	--------	--------	--------	--------	--------	
1911	2,997,072	5,299	--------	--------	9,318	--------	--------	
1912	2,753,408	6,198	--------	--------	15,526	--------	--------	
1913	2,491,505	7,571	--------	--------	8,063	--------	--------	
1914	2,800,713	5,295	74	2,377	14,895	--------	--------	
1915	2,703,710	5,254	132	4,174	149,292	--------	--------	
1916	3,167,723	5,934	314	14,301	42,685	4,817 lbs.	1,185	Copper.
						--------	6,000	Other minerals
1917	3,667,673	6,591	149	8,869	28,863	--------	--------	
1918	3,767,933	13,796	189	12,930	43,338	--------	6,888	Other minerals.
1919	4,195,732	12,276	[4]125	13,098	40,439	--------	--------	
1920	3,467,769	16,502	113	14,395	74,943	--------	40	Other minerals.
1921	4,738,248	26,135	179	14,396	73,387	--------	100	Other minerals.
Totals	$52,564,762	$141,254	1,275	$84,540	$512 149	--------	$605,527	

[1] Includes crushed rock, sand, gravel.
[2] Recalculated to 'commercial' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] Includes some palladium.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as by those who utilize the facilities of the collection.

During the month a total of 497 visitors signed their names to the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures. During the eleven months of 1922 to date, a total of 5207 visitors have thus registered their presence in the Museum.

LABORATORY.

FRANK SANBORN, Petrologist.

In a mineralogical, as well as a possible commercial way, one of the most interesting samples received this year at the laboratory of the State Mining Bureau was of anapaite. Anapaite is a greenish-white phosphate of calcium and iron found previously only in Russia, and named after the seaport of Anapa. A sample of rock received last June from Tulare County proved to be anapaite, being the first reported occurrence of the mineral in the United States. This mineral could be commercially valuable as a phosphate rock if found in sufficient quantity.

Between January first and November 15, 1922, approximately 2813 samples were received and determined. Of this number 316 were reported as having a commercial value or a possible one. Many high-grade gold, silver, copper and lead ores were received; also good grades of platinum-bearing sand, salines, etc. Radio-activity was reported in two instances. The occurrence of the rare-earth metals and vanadium was also reported.

A few of the hundreds of samples received each year tend to show the observing and highly optimistic nature of the senders. Metal-bearing samples have been received from well-drillers with an explanation that at a certain depth a peculiar metal was encountered. The metal usually proved to be a metallic part of the equipment that had become, through some mishap, ground to a dust. A too-generous application of lubricating oil to the pumps has caused films of oil to form on well water, and incidentally an oil excitement in some households. Likewise the man who disposed of the cleanings from his crank-case by pouring it in his neighbor's basement was the cause of a temporary thrill.

Prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. The number of determinations made annually by this laboratory has doubled during the past five years. Each year new occurrences of some mineral for the state are reported and occasionally a new mineral species is found and named. Frequently a new use for a mineral is found and the value of the particular mineral will advance in price. Cobalt is one such mineral that had a sudden increase in value. In studying the wonderful properties of such minerals as tungsten and vanadium, one would expect to hear of new uses for these metals, causing the state to be thoroughly searched for more of these valuable ores.

Samples are received from every county in the state. However, some of the counties, such as Alpine and Mono, are seldom heard from and it is reasonable to suppose that valuable minerals other than gold and silver will be unearthed in those rugged and sparsely settled counties.

A total of 231 samples was received and determined during the thirty-day period ending November 15. From this number those having a possible commercial value, judged from the sample submitted only, are appended.

The bureau will supply upon request the name and address of the party who sent in any sample listed if the reference number is given.

05–313	Vanadinite (lead vanadate).
05–314	Chromite.
05–315	Gypsum.
05–316	Copper-silver-lead ore.
05–317	Copper ore.
05–318	Quartz containing copper, silver, and gold.
05–319	Chrysoprase.
05–320	Gypsum.
05–321	Gold ore.
05–322	Montmorillonite.
05–323	Limestone marl.
05–324	Amphibole (asbestiform).
05–325	Copper ore, contains some gold.
05–326	Hydrous fluo-silicate of magnesium.
05–327	Mineral paint.

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Water-Supply Paper No. 482—Surface Water Supply of the United States, 1918. Part XII. North Pacific Slope Drainage Basins. A. Pacific Basins in Washington and Upper Columbia River Basin. By Nathan C. Grover, Chief Hydraulic Engineer; G. L. Parker and W. A. Lamb, District Engineers.
- Water-Supply Paper No. 484—Surface Water Supply of the United States, 1918. Part XII. North Pacific Slope Drainage Basins. C. Lower Columbia River Basin and Pacific Slope Drainage Basins in Oregon. By Nathan C. Grover, Chief Hydraulic Engineer; F. F. Henshaw and G. L. Parker, District Engineers.
- Water-Supply Paper No. 490-C—Routes to Desert Watering Places in the Lower Gila Region, Arizona. By Clyde P. Ross.
- Bulletin No. 735-F. General Features of the Brown Hematite Ores of Western North Carolina. By W. S. Bayley.
- Secondary Metals in 1921. By J. P. Dunlop.
- Mineral Resources of the United States, 1919, Part 1, Metals.
- Coke and By-products in 1919-1920.

U. S. Bureau of Mines Reports of Investigations:

- Serial No. 2392—A New Instrument for Sampling Aerial Dust. By Leonard Greenburg (Asst. Sanitary Engineer (R.), U. S. Public Health Service) and George W. Smith (Junior Physical Chemist, U. S. B. M.).
- Serial No. 2393—Production of Alumina from Clay Tests on the Miguet Process. By Clyde F. Williams (Metallurgist and Superintendent, Northwest Experiment Station, B. of M.) and Clarence E. Simms (Electrometallurgist, B. of M.).
- Serial No. 2394—Gum-Forming Constituents in Gasoline. By N. A. C. Smith (Petroleum Chemist, U. S. B. M.) and M. B. Cooke (Asst. Ref. Engineer, U. S. B. M.).

Serial No. 2395—Explosives Used in July, 1922. By W. W. Adams (Statistician, U. S. B. M.).

Serial No. 2396—Feldspar Mining and Milling, (Near Keene, New Hampshire). By Raymond B. Ladoo (Mineral Technologist, U. S. B. M.).

Serial No. 2397—Gunite in Metal Mines. By Byron O. Pickard (D. M. E., U. S. B. M.).

Serial No. 2398—Explosion-Proof Electrical Equipment. By L. C. Ilsley (E. E., B. M.).

Serial No. 2399—Fatalities at Coal Mines in August, 1922. By W. W. Adams (Statistician, B. M.).

Serial No. 2400—Fire and Explosion Hazards of Petroleums and Petroleum Products. By S. H. Katz (Asst. Physical Chemist, B. M.) and N. A. C. Smith (Petroleum Chemist, B. of M.).

Bulletin No 188—Lessons from the Granite Mountain Shaft Fire, Butte. By Daniel Harrington.

Bulletin 193—Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1916–1919. By Arno C. Fieldner, Walter A. Selvig and J. W. Paul.

Bulletin No. 209—Fusibility of Ash from Coals of the United States. By W. A. Selvig and A. C. Fieldner.

Bulletin No. 210—Oil Shale—an Historical and Economic Study. By Martin J. Gavin.

Bureau of Standards Circular 121—Construction and Operation of a Two-Circuit Radio Receiving Equipment with Crystal Detector.

Circular No. 85—United States Government Specifications for Basic Sulphate White Lead, Dry and Paste.

Circular No. 87—Recommended Specifications for Zinc Oxide, Dry and Paste.

State of Colorado, Bureau of Mines—Annual Report for 1921.

Florida Geological Survey—Fourtenth Annual Report.

Michigan Geological Survey—Bulletin No. 32—Production and Value of Mineral Products in Michigan for 1920 and Prior Years.

Bulletin of the Illinois State Museum—The Origin of the Cahokia Mounds. By A. R. Crook.

Geological Survey of Ohio, Fourth Series—Bulletin No. 25—Pottsville Fauna of Ohio. By Helen Morningstar, Ph. D.

Virginia Geological Survey—Bulletin No. XXIII—Manganese Deposits of Western Virginia. By G. W. Stose and H. D. Miser.

New Zealand Mines Department, Geological Survey Branch—Sixteenth Annual Report.

New Zealand Journal of Science and Technology. Vol. V. No. 3—The Genesis of the Puhipuhi Cinnabar Deposits. A working Hypothesis. By W. H. Cropp.

Annals da Bibliotheca Nacional do Rio de Janeiro. Vol. XXXIX. By Dr. Manoel Cicero Peregrino da Silva.

Boletin Bibliographico da Bibliotheca Nacional do Rio Janeiro. Anno III.

Notes on Mining in Siam: Issued by the Royal Dept. of Mines, Bangkok.

Annual Report of the Under Secretary for Mines, Queensland, 1921.

Societies and Educational Institutions.

University of Texas Bulletin No. 2230—Notes on the Oil and Gas Fields of Webb and Zapata Counties. The Underground Position of the Austin Formation in the San Antonio Oil Fields. By E. H. Sellards.

University of Texas Bulletin No. 2232—Well Records in Panola County, Including Structural Contour Map. By E. H. Sellards.

Records of the Australian Museum. Vol. XIII, No. 6.

Smithsonian Institution, United States National Museum Bulletin No. 121—Life Histories of North American Petrels and Pelicans and their Allies. By Arthur Cleveland Bent.

The Science Reports of the Imperial University, Sendai, Japan, Second Series (Geology).

The Science Reports of the Tohoku Imperial University, Sendai. Vol. 1, No. 2. Japan.

Bulletin of the Institution of Mining and Metallurgy, October, 1922.

Journal of the American Peat Society, October, 1922.

The American Mineralogist, October, 1922.

Monthly Bulletin of the Canadian Institute of Mining and Metallurgy, November, 1922.
Economic Geology. November, 1922.
Proceedings of the Engineers' Society of Western Pennsylvania, May, 1922.

Maps.

Irrigation Map of California. By U. S. Dept. of Agri., Bureau of Public Roads.
U. S. Geol. Survey—Map Showing Oil and Gas Fields of the United States.
U. S. Geol. Survey—Topograph Sheet—San Ardo, Monterey County.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport-Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Georgetown Gazette, Georgetown, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.

Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Etna Mills, Cal
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Stockton Record, Stockton, Cal.
Sunset Journal, Sunset District, San Francisco, Cal
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–137 Good copper prospect; San Benito County.
02–138 Soapstone and asbestos; deposit or tonnage.
02–139 Magnesite mine; 100 tons on dump and large tonnage in sight; reasonable price.
02–140 Property with high-grade gold vein in amphibolite schist; 20 acres.
02–141 Property with porphyry vein 10 to 75 feet wide; 12,000 feet in length. Heavy deposit of sulphides.
02–142 Drift mine near Nimshew; or partner to help work.
02–143 Barite deposit. Five miles from railroad; three miles from water transportation; good road to the deposit.
02–144 Diatomaceous earth deposit; will lease.
02–145 Gypsum in car or train lots, or deposit.

Mineral Products or Deposits Wanted.

03–121 Feldspar; tonnage.
03–122 Volcanic cinders; prefer near Los Angeles.
03–123 Coal deposit within reasonable distance of highway or railroad; two-foot vein or over.
03–124 Concentrates from quartz ores; no objection to arsenic content.
03–125 Block pumice; tonnage.
03–126 Gypsum deposit suitably located.
03–127 Second-hand gold dredge; 10 to 15-cubic-foot buckets.
03–128 Fluorspar, magnesite, and dolomite; tonnage.

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and address of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–41 Geologist or mining engineer. Two years experience, including mining, highway construction, geology and surveying. Age 25; married. References. Salary wanted, $175.

01–42 Mining engineer. Over fifteen years experience, covering general mining and mine management. Speaks Spanish; can handle any kind of labor. Prefer position on desert. Details of experience on file. Married. References. Salary open.

01–43 Engineer, draftsman, etc. Technical graduate. Experience as mill-man, engineer, petrographer, and general engineering. Age 29; married. References. Salary wanted, minimum, $150.

01–44 Draftsman-Surveyor. Fifteen years experience as surveyor, draftsman, inspector, etc., in mining, mechanical, railroad, and structural lines. Age 35; single. References. Salary wanted, $150.

DECEMBER, 1922

REPORT XVIII OF THE STATE MINERALOGIST

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each division working out from a local branch office.

This move brought the Bureau into close personal contact with operators, but did not materially shorten the time between the gathering of data in the field and their publication in the Report of the State Mineralogist at the end of an annual or biennial period.

Mining activities and development noted by district engineers in their respective fields are now embodied in monthly reports published in each issue of 'Mining in California,' thus making these data available within a maximum period of thirty days, and the Monthly Chapter as far as possible a compendium of current mining progress throughout the State.

The counties included in each field division and the location of the local offices are shown on the accompanying outline map of the State. (Frontispiece.)

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

REDDING FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

Shasta County.

Climax Mine is situated three miles northwest of Igo, on the South Fork of Clear Creek, in sections 16 and 21, T. 31 N., R. 6 W., elevation 1200 feet.

This property was briefly mentioned in the July Chapter of Report XVIII of the State Mineralogist, page 320, as at the time the property was visited the shaft was full of water, but since that date the workings have been unwatered, thus enabling a more detailed report to be made on the mine.

Holdings consist of three claims, known as Climax, South Climax, and West Climax, totaling 60 acres. The occurrence of the veins on the Climax group of mines is somewhat different than the main northeast and southwest fissures that occur in the granite batholith in the South Fork mining district, as the principal vein developed on the Climax group of claims occurs on the contact of the granite and meta-andesite. The granite is the footwall and meta-andesite the hanging wall of the vein. The general strike of the contact is N. 10° E., dip 50 degrees east. No prospecting or development work has been attempted to date to determine the possibility of finding ore on the intersection of the northeast and southwest veins with the contact and this point is worthy of investigation. The vein which occurs on the contact is a black carbonized slate cut by numerous stringers of quartz, and in places this carbonized vein material is replaced by quartz.

The enclosed vein material is mineralized with pyrite, chalcopyrite, small amounts of galena, and some sphalerite. About eighty feet west of the contact, a vein of quartz occurs in the granite, having the same general strike and dip as the vein on the contact. Two hundred feet west of the Climax shaft is another system of quartz veins in the granite. One strikes N. 40° E., and dips 80 degrees east, the other strikes N. 20° E. and dips 70 degrees east. Average widths of veins is 4 feet.

These two veins intersect the contact north of the Climax shaft. The vein quartz shows the presence of silver chlorides and some galena. On the Climax claim, a shaft has been sunk to depth of 150 feet on a vein in the granite running parallel to the main contact vein. On the 100-foot level, a drift has been driven south 50 feet and north 40 feet on the vein, developing a lenticular shoot of ore fifty feet in length, width of ore being from 12 inches to 2 feet. The vein pinched below this level, and the shaft was sunk in the granite footwall to the 150-foot level. On this level a crosscut has been driven east 75 feet cutting the contact vein which has a width of 10 feet.

Vein material is black carbonized slate, containing numerous stringers of quartz. South of the Climax shaft about 150 feet, there is an incline shaft, 75 feet deep on the contact vein, which has been stoped to the surface north and south of this shaft for a distance of 100 feet.

The Black Prince shaft is 150 feet south of these workings, and was sunk to a vertical depth of 110 feet. The shaft started on the contact vein, but a short distance below the collar cut through the vein and passed into the granite footwall.

On the 100-foot level a crosscut was driven east to the vein on the contact, where it is reported to have a width of 10 to 20 feet. The average value of the ore extracted from this vein is reported to have been $10 per ton in gold and silver.

On the South Climax claim there is a shaft 33 feet deep, which cut the vein on the contact. The vein quartz carries native silver, tetrahedrite, sphalerite, chalcopyrite, pyrite, and some gold mostly associated with the pyrite. A shipment of ore from the Climax shaft was made to the Selby Smelter in 1922, amounting to 4210 pounds, which assayed 0.08 ounces gold, 214.9 ounces silver, 6.6 per cent lead, and 25.2 per cent zinc.

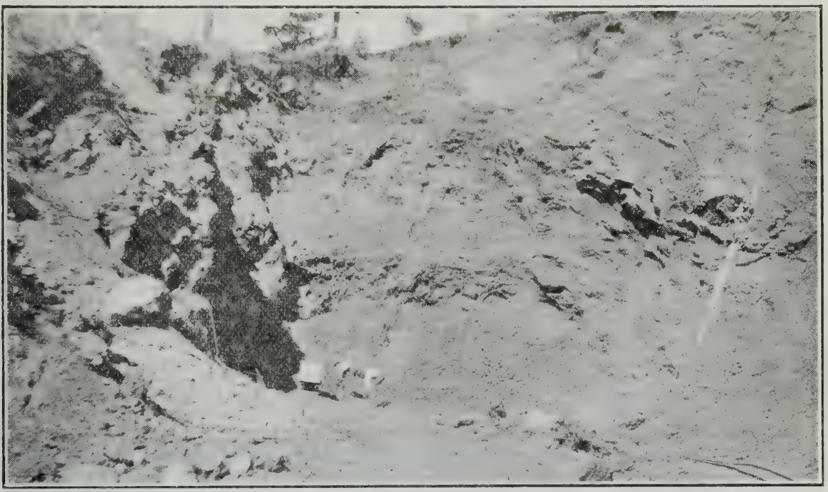
Mine equipment consists of 9-h.p. gasoline hoist, 6″ x 4½″ Gardner compressor, driven by 15-h.p. Fairbanks-Morse gas engine, blacksmith shop, air drills, and assay office.

Two men are employed. Owner: W. W. Robinson of Redding; Louis Davidson, superintendent.

Ganim Mine is situated in sections 5 and 8, T. 32 N., R. 6 W., two and one-half miles northwest of Whiskeytown. Elevation is 1400 feet. Holdings consist of 14 claims, owned by the Ganim Mining Company, San Francisco. J. S. Ganim, president, and A. Farris, secretary.

The country rock is meta-andesite with intrusions of alaskite porphyry. Two vein systems have been developed on the property. One showing pyrite ore, occurring in a shear zone which strikes northwest and southeast and dips 25 degrees north. The country rock at a distance from the ore is a much sheared and epidotized meta-andesite in places slightly pyritized along joint planes. The lower workings on the property are not far from a contact of meta-andesite, quartz-diorite and dikes of alaskite porphyry which cut the meta-andesite in the vicinity of the tunnels. The ore where exposed near these workings is entirely pyrite. Besides the pyrite, the only other metallic minerals are rare specks of chalcopyrite, distributed irregularly throughout the ore. Other specimens of ore consist of meta-andesite in part replaced by pyrite. Developments consist of a number of crosscut tunnels which cut this shear zone at different places. These tunnels are from 50 to 400 feet in length. The ore developed has a width of 12 to 15 feet and is reported to carry values in silver. At higher elevation, a vein of quartz 4 feet in width has been developed. Strike of vein is N. 35° W., dip vertical.

At an elevation of 1800 feet, a crosscut tunnel has been driven N. 40° E., 120 feet to the vein, with a drift northwest 100 feet on the vein. The ore is white quartz carrying copper sulphides, bornite and chalcopyrite. Reported to carry $15 per ton in gold. This vein is developed by three other tunnels, and two shallow shafts. The company is driving a crosscut tunnel at a lower elevation to develop the veins exposed in upper workings.



Upper Quarry on Magnetite Deposit, Shasta Iron Company, Heroult, Shasta County.

Equipment: 9″ x 14″ Simplate Valve Chicago Pneumatic compressor, Lyner drill sharpener, air drills and blacksmith shop.

Four men are employed; J. S. Ganim, manager.

Blue Gravel Mine (formerly *Brush Placer Mine*) is located one mile southwest of Redding in section 2, T. 31 N., R. 5 W.; owned by *St. Adel Mining Company*, V. L. Thornberry, agent, Bush street, San Francisco.

Holdings consist of 80 acres. Elevation is 700 feet. Course of blue gravel channel is northeast and southwest. Depth of gravel 80 to 100 feet. Bedrock is meta-andesite. An incline shaft has been sunk 50 feet to bedrock with a drift driven west on the channel 30 feet.

Equipment consists of 2-inch centrifugal pump, and gasoline hoist. Under lease of J. A. Burger and L. V. Stowe of Redding, California.

Four men are employed on development work.

IRON.

Shasta Iron Mine is situated one mile north of Heroult, in section 26, T. 34 N., R. 3 W., at an elevation of 1700 feet. Holdings consist of 200 acres of patented land. Under lease to the *Noble Electric Steel Company*; H. H. Noble, president; E. E. Mead, secretary; E. Y. Dougherty, superintendent; offices 384 Mills Building, San Francisco.

The iron ore occurs on contact between McCloud limestone and quartz-augite-diorite. The ore is chiefly magnetite, with abundant limonite on the surface. The body of magnetite is large, but follows the contact of the limestone and diorite with great irregularity. A massive deposit of magnetite is exposed by two opencuts near the top of the ridge, and at an elevation of 1850 feet, the upper opencut or quarry shows an exposure of ore 150 feet in width and 70 feet in height from the floor of the quarry to the surface outcrop.

On the north slope of the ridge a tunnel has been driven 300 feet southwest intersecting this ore body 300 feet below the outcrop. To the southwest at 140 feet below the floor of the upper quarry, the ore body is exposed by another quarry; here the width of the deposit is 150 feet. On the south slope of the ridge, about 300 feet below the floor of the lower quarry, a tunnel has been driven 300 feet north, which cut the deposit.

The general strike of the deposit is northeast and southwest. The ore body exposed in these workings is 1000 feet in length by 150 feet in width. Estimated tonnage of commercial ore developed is reported to be 1,000,000 tons.

The ore mined and shipped runs 65 per cent iron, 3.4 per cent silica, .02 per cent sulphur and .012 per cent phosphorus.

The ore is trammed from the lower quarry level, a distance of 1½ miles to bunkers at the head of an incline tram line. It is then delivered over the tram line 1600 feet in length to bunkers at Heroult, on the Sacramento Valley and Eastern Railroad. Shipping 12 to 15 cars of iron ore per month to Los Angeles, Oakland, and San Francisco.

Limestone Quarry of the Shasta Iron Company, Heroult, Shasta County.

LIMESTONE.

This company also owns an extensive deposit of limestone which lies west of the iron deposit. On the same elevation as the lower quarry on the iron deposit, a large quarry has been opened up on this belt of limestone.

The quarry face is 200 feet in length with a height of about 100 feet above the floor of the quarry. The limestone is trammed over the same tram line as the iron ore. At the time that the Shasta Zinc and Copper Company's smelter was operating the company was shipping 12 cars per month of lime rock to Winthrop, over the Sacramento Valley and Eastern Railroad.

The following is an analysis of the limestone: SiO_2, 1.02%; Al_2O_3, 0.61%; MgO, 1.12%; CaO, 53.80%; FeO, 0.20%; CO_2, 43.25%.

Twelve to fifteen men are employed.

The *Summit Copper Company* has deeded to the *Stauffer Chemical Company* of San Francisco, the Summit group of copper claims in the vicinity of the Mammoth copper mine, near Kennett. The group includes fifteen patented claims.

Lawrence Gardella of Oroville, who is operating two gold dredges on Clear Creek, four miles below Redding, has recently acquired additional dredging ground by bonding the ranch of W. N. Hoskin, which lies directly west of his present holdings. He has also secured a bond on the property owned by the J. P. Jones estate.

The *Shasta Zinc and Copper Company*, whose property is located at Winthrop, have shut down the Bully Hill mine and smelter. It is reported that the company, after making some changes in the present plant, will resume operations in the spring.

Siskiyou County.

Placer mining is now active at Happy Camp, Sawyer's Bar and in the Humbug district.

The *Shadows Creek Hydraulic Mine*, situated near Cecilville, is being operated by E. M. Robertson, Albert Brown and D. O. George. A derrick and Pelton wheel have been recently installed on the property.

Rainbow Mine is situated one and one-half miles northwest of Hawkinsville. In recent development work on the property, a ledge was cut about 50 feet below the surface in a tunnel 90 feet in length. The vein quartz shows free gold, some galena and pyrite. T. C. Quin, of Hawkinsville, owner.

The asbestos deposit owned by M. S. Russel of Edgewood was recently purchased by the *National Cement Company* of Modesto. It is reported that this company expects to develop the deposit in the spring.

In 1921, asbestos rock with estimated content of 25 per cent of short fibre, was shipped from the property.

Trinity County.

Lewiston Gold Dredging Company. Buckley Wells, president; A. D. Snedgrass, secretary; Gerald H. Hutton, manager; Milan A. Senger, superintendent. Offices 582 Market street, San Francisco.

The holdings of the company are located in sections 22, 28 and 33, T. 34 N., R. 8 W., 7 miles north of Lewiston on the Trinity River.

The distance along the river to be dredged is about 3½ miles. The depth of ground varies from 12 to 30 feet, the gravel being loose river wash, with some cemented gravel and large boulders. The bedrock is meta-andesite and slate and is hard in places along the river. The dredge was originally constructed by the Union Iron Works of San Francisco, and prior to 1922 was operated by the Valdor Dredging Company on the Trinity River below Junction City. During the year the dredge was dismantled and transported to its present location, the boat being rebuilt and heavier equipment installed. The dredge was launched on October 31st, and it is expected to be placed in operation on January 1, 1923. The dredging ladder is of plate-girder construction, carrying sixty-nine 7-cubic-foot buckets. The electric power equipment installed on the dredge has a rated capacity of 350 horsepower. A revolving type of screen is used. The gold saving tables have a total area of 1550 square feet on a single deck and are equipped with steel-lined Hungarian riffles. The monthly capacity of this dredge is 150,000 cubic yards.

Electric power is furnished by the Pacific Gas and Electric Company. The receiving line voltage will be 2200 and this will be reduced to 440 volts by transformers on the dredge. The company is now examining the Paddon property adjacent to the Foster Ranch on the Trinity River, in T. 36 N., R. 7 W.

Two Keystone drills are being operated under the supervision of M. A. Senger, field engineer for the company.

Gardella Dredge, owned by Louis Gardella of Oroville, was placed in operation in October, 1922, on the Paulson Ranch, 1½ miles southwest of Lewiston. It is being operated upon a gravel bar at a bend in the Trinity River opposite Rush Creek, section 3, T. 33 N., R. 9 W.

The depth of ground varies from 10 to 20 feet. The character of the gravel is course, overlain by clay and loam, with some cemented gravel and large boulders. The bedrock is hard diorite and slate.

The dredge is a wooden hull, bucket elevator and electrically driven. The digging ladder carries sixty 7-cubic-foot close connected buckets. The tailings stacker is a Robbins belt conveyor, approximately 96 feet long, carrying 30-inch belt. The electric motor equipment installed on the dredge has a rated capacity of approximately 300 horsepower. A revolving type of screen is used, 6½ feet diameter with length of 30 feet. Gold saving tables have a total area of 1500 square feet and are equipped with steel Hungarian riffles.

Electric power is furnished by the Pacific Gas and Electric Company. Nine men are employed; Claude V. Enslow, superintendent.

Trinity Gold Dredging Company commenced operations in 1913 and the dredge has been operated almost continuously to date. Holdings of the company comprise 900 acres on the Trinity River, in sections 5, 6, 7, 8, 32, and 33, T. 33 and 34 N., R. 8 W., four miles north of Lewiston.

The average depth of the ground is about 30 feet. The character of the gravel is loose with large boulders and some cemented gravel. Bedrock is slate, hard and tilted, with some meta-andesite.

The dredge is an 11-cubic-foot wooden hull boat. It is an open-link-bucket-elevator dredge, equipped with tail sluices. The digging ladder is of steel construction, 83 feet long and carries thirty-nine 11-cubic-foot buckets. The buckets are triangular in section, flaring upward from the bottom. The revolving screen is of manganese steel construction, 12 feet long, 6 feet in diameter and unlike most screens is provided with perforations from 6 to 10 inches in diameter. The screen discharges into two chutes, which discharge on either side of the boat. Thus all the large gravel and boulders fall on either side of the hull back of the center line. The undersize is discharged into a sluice box 200 feet long, which is 4 feet wide by 2 feet deep. The gold is saved on longitudinal manganese steel riffles; the tailing being washed to the discharge point by a heavy current of water. The tailing forms a level pile only a few feet above the level of the water in the pond. Due to difficult digging ground the bucket speed of the dredge is low.

Electric motor equipment installed on the dredge is rated at 375 horsepower. Twelve men are employed. Owner: Trinity Gold Dredging Company; E. L. Smith, president; H. E. Chesboro, secretary and manager; E. O. Smith, superintendent; offices Chico, California.

Estabrook Gold Dredge Near Trinity Center, Trinity County.

Estabrook Gold Dredging Company. This company began operations on the Trinity River in June, 1919, and operated until 1920, when operations were suspended, but the dredge was again placed in commission on November 28, 1922. The holdings of the company consist of 2000 acres along Trinity River, north of Trinity Center, in T. 36 and 37 N., R. 7 W.

The depth of ground is from 25 to 50 feet, the average depth being about 40 feet. The placer channel is up to one-half a mile wide. The gravel is coarse and loose, with large boulders. In places cemented gravel has been encountered but as a rule the gravel is loose and free, lying on a bedrock of serpentine, slate and granodiorite, which is hard.

The dredge is of wooden hull construction, equipped with 20 cubic-foot close connected buckets. Revolving type of screen is used, diameter 6½ feet, with a length of 33 feet. The gold saving tables have a total area of about 2000 square feet on a single deck and are equipped with steel-lined Hungarian riffles.

The rated daily capacity of the dredge is 12,000 yards. Electric power is furnished by the Pacific Gas and Electric Company. Eighteen men are employed. Owner: Estabrook Gold Dredging Company, W. H. Estabrook, president; Charles Stetson, secretary; W. H. Estabrook, superintendent; offices 53 State street, Brockton, Massachusetts.

AUBURN FIELD DIVISION.

C. A. Logan, Mining Engineer.

I. Condition of Metal Mining in the Auburn District, 1922.

The close of the year is a good time for a general brief summary of the progress made during 1922 in this branch of the industry and for speculation as to what may be reasonably hoped for in the near future.

Beginning in Plumas County, we find that little has been done in the way of quartz mining during the year. The *Philadelphia Exploration Company* spent several years in reopening the *Green Mountain* and *Crescent Mines* at Crescent Mills and in extensive exploration below the deepest old levels. This work the company's manager reported as disappointing. Early in 1922 they gave up both properties and pulled out after expending several hundred thousand dollars. Some work has been done during the year near Greenville on the *New York* and *Arcadia* claims under the direction of Walter Parsons. A small hoist and some buildings were put on the old *Emigrant Hill Mine* two miles north of Quincy, by Judson Coats. After reopening the old shaft and working a few weeks the property was closed down.

The reports of good gravel coming from the *Feather Forks* and *Maxine Mines* in Little Grass Valley have led to investigation of other claims in the same district. In October W. D. Stone and other claim owners gave leases and options on nearly three sections of placer claims which the lessee proposes to drill. The *Wood Estate Company* has been prospecting with a Keystone drill off and on for several seasons just west of the Maxine Mine but has not had any definite results yet. One of the sensational pocket discoveries of the season was reported early in August, when James Burroughs, hunting pockets near Onion Valley, was said to have taken between 30 and 35 pounds of gold from a small hole near the surface. There was no opportunity to see Burroughs or to substantiate the story.

Besides the activities mentioned in the last monthly bulletin, there was the usual seasonal work on small placers in the Seneca-Long Valley region, which has not been visited this year. The metal production for the year has been almost entirely from the *Engels* and *Walker Copper Mines.* The production of these two mines will place Plumas County first in the state in copper production, second in silver and a close contender for fourth place as a metal producer, possibly displacing Amador County.

Sierra County has experienced a healthy revival of quartz mining during the year, there having been great activity in the Alleghany district. The mines there were described in considerable detail in the October chapter. The ore found in this district is apt to be of such high grade that operators have been justified in resuming work and in starting new operations in spite of sustained high costs. Underground men received $3 a shift in 1915 in this camp. Muckers are now paid $4.50 and $4.75 and miners $5 and $5.50, but to offset this, board and lodging that formerly cost about $30 a month now costs the men $50 a month, and the quality of food does not compare favorably with that furnished at Mother Lode camps for $35 a month at present.

At the *Young America Mine,* 4 miles north of Sierra City, a Gibson mill was installed late in the summer to regrind tailing of which there is estimated to be 50,000 tons or more. Other projects in the same vicinity include the proposed reopening of the *Bigelow Mine* and the *Keystone Mine.*

The *Bigelow* at Sierra City is being promoted by a stock company known as *Sierra Buttes-Bigelow Consolidated Mines,* incorporated in Delaware and capitalized for $1,500,000. Chas. J. Fox of Philadelphia is president, W. H. Martin of Nevada City, vice president, and E. C. Klinker, engineer for the company. In November it was announced that the equipment of the Monarch Mine nearby would be bought and moved to the Bigelow. A plan has been entertained to develop the mine through No. 9 tunnel of the Sierra Buttes Mine, which adjoins on the west.

The *Keystone Gold Mining Company* has been organized under the laws of Delaware to work the *Keystone Mine*, three miles southwest of Sierra City. James H. Davis and Ernest M. Innes, both of Sierra City are president and vice president and Frederick Gilmour, 1460 Union street, San Francisco, is secretary-treasurer. Early in December Mr. Gilmour reported that by the middle of next summer they hope to have the property in good shape again. They expect to put new rails in the tunnel, reset the mill, build necessary buildings and put in a new compressor.

The operators of the *Oro Mine,* just south of Downieville, laid plans early in summer for a new lower adit to develop the prospect at depth. It was estimated this would have to be driven about 1000 feet.

Small scale operations have been carried on at a great many other mines and prospects during the summer. Among these are the *City of Six, Black Bear, Finney, Mt. Vernon, Snowden Hill, Sierra Highland, San Fernandez, Hilda,* and *Kirkpatrick.*

Brandy City Hydraulic Mine is again being prepared for operation as soon as water is plentiful. H. L. Berkey and Bayley Hipkins have announced plans for hydraulic mining at Scales and Council Hill.

Besides the continued steady operation of the *North Star* and *Empire Mines* at Grass Valley, which keep Nevada county in the lead in quartz gold production, and the persistent prospecting operations of the *Idaho-Maryland Mines Company,* a number of small projects have shown progress during 1922, although there has been little actual gold production in the county besides that of the first two named companies.

New equipment and electric power are being provided for the *Grass Valley Boundary Mines* under the management of M. J. Brock. The property includes several claims just west of Grass Valley. No underground work has been done lately. The deepest of the numerous shallow workings is between 250 and 300 feet.

The shaft at the *Normandie Mine* has been continued, reaching a depth of 350 feet in October. New machinery has been installed here also during the summer to facilitate sinking.

The *Osceola Mining Company* near Rough and Ready has done a little work, including bringing in a water supply for power. The *Alta Combination Company* and the *Alcalde Gold Mines Company* have continued work with small crews.

The *Newtown Mining Company* has been active under the management of Lester M. Dull and a depth of 150 feet has been reached. Some work has been done on the Ross prospect and the Thomas Bath claims.

The reopening of the *Brunswick Mine* was begun in July and has been progressing during the fall. A large hoist has been placed and bailing of the water is under way. The work is being done by the owners under stock assessments.

In the district near Washington, the principal item of interest has been the reopening of the *Eagle Bird Mine*, six miles east of the town. Work has been going on all summer and a new ten-stamp mill has lately been put up. Unwatering is going on. J. H. Harris is superintendent. Frank Sizer has been in charge of work at the *Yuba Mine* on the river about a mile from the Eagle Bird.

Satisfactory progress has been made at the *Gold Lead Placer Mine* at North Bloomfield, where work has been going on for a year and a half. At last account, about a dozen men were employed. A lower tunnel has been driven and upraises are being made to test the overlying gravel.

At the old *Malakoff Mine* at North Bloomfield the *Malakoff Leasing Company* was formed after the original lessees found the opening of the mine too expensive for their unaided resources. When bedrock was reached in the shaft the past spring a flattering prospect was reported. Since then a Cornish pump has been installed and the shaft has been sunk to 283 feet, allowing room for exploiting the gravel by a drift in bedrock under the channel and raises into the gravel.

Quaker Hill Mines Company, under the local management of Henry Schnitzel of Nevada City, has continued prospecting their extensive holdings at Quaker Hill. While a great deal of gravel is reported to have been opened at this property it is believed for the most part to be rather too low grade to pay for drifting.

Liberty Hill Hydraulic Mine was operated last winter and the past spring under an agreement between the owner and a party of local miners. A small production was made.

In Placer County little has been done during the year in the way of new work. Early in the year the *Oro Fina Mine* in the Ophir district was shut down following the death of the manager, Haines Gridley. This mine had been producing at the rate of about $100,000 a year for five years and was the principal quartz mine in operation in the county. With the exception of the *Pioneer Mine*, which mills ore irregularly, there are no other quartz mines actually producing now in the county. The *American Bar Mine*, near Michigan Bluff, showed promising prospects when visited during the summer and may once more become productive. At Succor Flat, near Iowa Hill, J. Starratt has lately been developing the *Adventure* quartz claim and encouraging prospects are reported. Late in the year Loren Corsaut became associated with Starratt and they plan to continue work this winter. Four men are employed. A little work was done at the *Rawhide* and *Walker Mines*.

~~XVIII~~ Rpt
1922

At Last Chance, Wm. Davis of Auburn and associates resumed exploration of the deep channel in the *Home Ticket Mine.* After crossing the channel from the bottom of the incline Davis quit work and reported that the gravel found was not of sufficiently high grade to drift at a profit under present costs. At Forest Hill George McAulay and Joseph Steiner of Auburn report that they have put a small crew at work during the present month in the old *Baltimore Drift Mine* and have taken options on the adjoining properties. Work will be directed toward finding the possible extension of the old Forest Hill channel west of the region where it was cut off by the Deep Blue Lead. It is planned to put up an inclined raise from the old workings. The *Glen Mine,* in Duncan Canyon, is the only drift mine known to have been productive during the year.

The Garbe and de Maria Mine, near Michigan Bluff, continues from time to time to yield specimen gold in crystallized forms that find ready sale to jewelers. This mine is in a class by itself; the gold occurs in narrow seams with or without quartz, and is recovered by hand, there being no mill on the property.

For the most part, the mines of El Dorado County have been inactive during 1922. Near Georgetown an interesting project is just getting under way. This is called the *Kelliher Mining Company.* J. B. Kelliher of Georgetown, C. and W. Henneuse of Sacramento and others are interested in partnership. They have a lease on 101 acres covering 4000 feet along Canyon Creek just downstream from Georgia Slide. It was formerly called the *Gold Bug Mine.* The deposit consists of the accumulation of hydraulic mining debris and material from erosion of the wide auriferous seam belt which crosses the creek at Georgia Slide, and was worked extensively many years ago at that place. The creek and the side gulches yielded a great deal of gold in the early days.

Machinery has been placed during the summer and fall preparatory to operation in the spring. Two drag line scrapers of 18 cubic feet capacity each will be used. These will be operated by a 30-h.p. tractor engine, running a double-drum hoist. The scrapers will be drawn up on an incline built of round timbers, and will dump into a trommel, designed especially by Kelliher and embodying some new ideas. After screening through this trommel, which is 10 feet long by 12½ feet in circumference with 1-inch holes, the gravel will be washed in sluices. A centrifugal pump run by a 20-h.p. engine will pump water for washing. Kelliher estimates this outfit can handle 200 cubic yards in eight hours. It may do so with the loose gravel near the surface, but when the deeper and more valuable ground is reached a good deal of hand work will be needed.

J. G. Lewis of St. Louis, owner of the *Red Hill Mine* near Garden Valley, has recently done some work on the property after winning a suit to quiet title.

After working all summer on the *Jones Mine,* near Placerville, a company of Bakersfield people expected to begin stoping ore at last report early in November.

The mining districts of this county are deserving of much closer investigation than has been given them in late years. Development is held back by reason of the great number of nonresident owners, who do not know enough about their own properties in many cases to promote a feeling of interest on the part of the possible inquirer. The only operations on the Mother Lode during the year in this county have been the milling of the dumps at the *Havilah Mine* at Nashville, a little work on claims near the old Union Mine, and the usual assessment work. On the East Belt there has been a little done in the Slate Mountain district.

Yuba County will be the leading gold producing county again this year by virtue of the dredging operations on Yuba River near Hammonton and Marigold. Outside of these operations, which have been described in past publications, there has been little metal production in the county. The November chapter contains notes on quartz mining in the county. Besides activity noted there, some work has been going on in Dobbins district. The *Thoroughbred Mining Company* has been lately driving an adit on the *George property.*

The leading event of the year in the county in the way of new development was the beginning of work on the *Yuba Development Company's* dam at Bullard's Bar. The completion of this dam will make available a large space for the storage of hydraulic mining debris. It is reported that three cents a cubic yard will be charged for this use. There is a promise of resumption of hydraulicking when the dam is finished, as it will offer storage for numerous properties dumping into that branch of the river. This is the first of a series of five dams contemplated in the company's plans. Generation of electric current, and storage of water for irrigation are also contemplated. The completed project is expected to unlock gold resources worth several times the cost of construction, and to aid immensely in the development of the lower foothill and valley lands. Plumas, Sierra and Yuba counties will be immediately benefited, and the series of dams will be an effective aid in flood control further down the Sacramento Valley. The contract for hauling 250,000 sacks of cement for the dam was let late in July, and preliminary road building to the dam site began at the same time. The dam is expected to be completed during the coming summer.

(This review of mining in the district visited from the Auburn office will be completed in the January chapter.)

SAN FRANCISCO FIELD DIVISION.

C. McK. LAIZURE, Mining Engineer.

During the past thirty days the time of the district engineer has been entirely taken up with routine office duties and no field work has been undertaken.

A review of the condition of the industry in the San Francisco district during the year 1922 will appear in the January, 1923, issue.

LOS ANGELES FIELD DIVISION.

M. A. NEWMAN, Mining Engineer.

Inyo County.

Argus Sterling Mine. This property is situated 12 miles southeast of Darwin in the Argus Range of mountains. Consists of 12 claims through which run five veins which course northwest and southeast, carrying silver-lead ore. The veins occur in limestone. The oxidized zone carries the lead as a carbonate and sulphate; the unoxidized ore consists of galena. The veins average 3 to 4 feet in width. Development consists of a vertical shaft 180 feet deep. At the 155-foot level a drift has been run 245 feet, of which 150 feet is in ore. Owners claim to have at least 1000 tons of ore on the dump from this ore body which will run close to 50 per cent in lead and better than 20 ounces of silver per ton. There is also considerable tonnage in the old dumps of low grade silver-lead ore. A contract has been entered into with the Metal Supply Company of Los Angeles, for one 5-ton unit of their patent smelter, which it is claimed will be equivalent to a capacity of 40 tons per day.

It will be interesting to watch the results of this smelter operation, as in the past no commercial results have been obtained in small scale smelting. Crude oil will be used in smelting.

The company is organized under the laws of Arizona, and maintains offices at 511 Security Building, Los Angeles.

President, Hiram Harman; vice president, Conrad Woehr; treasurer, H. M. Kline; secretary, J. G. Dratz; superintendent, Thomas E. Reese.

Los Angeles County.

Los Padres Placer, Inc. This company has taken an option to purchase 230 acres of placer ground, located in T. 5 N., R. 15 W., S. B. M., in the Palomas Mining District, Texas Canyon. It also has two unpatented placer claims adjoining the above. Texas Canyon is 43 miles north of Los Angeles and 9 miles north of Saugus.

While portions of this placer ground have been worked in the past, the company believes that there still exists a large amount of gold-bearing gravel. A sub-lease has been given to other parties who agree to erect a dredge and have same ready for operation by October 4, 1923, paying to Los Padres Placer, Inc., a certain percentage of the gross value of all metals recovered.

Frank E. Rich and Louis M. Timmons are, respectively, president and secretary of the company.

Pacific Coast Borax Company. C. A. Zabriske, president of this company, has definitely confirmed the reports that his company is to build a large chemical plant on the site of the Chandler Shipbuilding Company, at Wilmington. At the present time crude and calcined borax is shipped to the Stauffer Chemical Works at San Francisco and to Bayonne, New Jersey.

The new plant at Wilmington is to refine and manufacture borax into its many products now in commercial use. It will take care of the entire Pacific Coast market, besides shipping to the Orient and Australia. The plant will also engage in the general manufacture of chemicals. Just what chemicals are to be made the company as yet is not ready to announce. The management announces that at least 200 men will be employed to begin with, and that this number will be gradually increased. It might be of interest to note that the parent British company of which the Pacific Coast Borax Company is a subsidiary virtually control the borax industry of the world. The only probable competition is that of the West End Chemical Company, which now owns the Callville borax mines, north of Las Vegas, Nevada.

F. M. Smith, formerly the owner of the Pacific Coast Borax Company, is now the leading spirit in the West End Chemical Company.

San Bernardino County.

American Magnesium Company. This company owns 1400 acres of placer ground, carrying soluble magnesium sulphates, located in T. 25 S., R. 46 E., M. D. M.

At the present time, a monorail line is being built from the deposit to a point six miles south of Trona. The road, when finished, will be about 30 miles long. It is proposed to run trains of 30 to 35 tons capacity over this line.

The monorail line will cost approximately $200,000, and it will be ready for operation some time in March, 1923.

A refinery is to be built at either Los Angeles or San Pedro, where magnesium carbonate and epsom salts are to be manufactured. The refined products are then to be sent direct to New York and there sold by brokers.

It can readily be seen that the company has a large field to expand in.

The company is incorporated under the laws of Nevada. Capital, $1,000,000 of $1 per share par value.

President, T. H. Wright, Los Angeles. Office, Washington Building, Los Angeles.

Arlyngton Mining Corporation. This company has taken over 8 unpatented mining claims in the Black Hawk Mining District. These claims cover the outcrop of a flat bedded vein. The development, to date, along the outcrop indicates a large tonnage of low grade gold ore said to average around $4 gold per ton.

It is estimated that approximately $50,000 will develop and equip the property for milling operations.

The company is organized under the laws of California. Capital stock, 1,000,000 shares of 25 cents par value. The property is under the control of R. K. Voorhies, formerly of the Chamber of Mines and Oil of Los Angeles, and Algernon Del Mar, a mining engineer of large experience in the United States, British Columbia, and Mexico.

California Rand Silver, Inc. This company has declared regular dividend No. 35 of two cents per share, representing a distribution of $25,600. This makes a total of 84 cents per share paid in dividends during the year 1922, or $1,075,200.

EXTRACTION AND ADVANCEMENT.

In November, there were extracted from shafts Nos. 1 and 2, 8972 tons of rock, as follows:

Milling ore	5,375 tons
Shipping ore	858 tons
Waste	2,739 tons
Total	8,972 tons

The advancement for the month, 1,519 feet, was as follows:

Drifts	1,162 feet
Raises	115 feet
Crosscuts	181 feet
No. 2 shaft	25 feet
No. 6 shaft	36 feet
Total	1,519 feet

Expenditures.

Due to mill construction, increased development, increased mining and preparation for handling the larger tonnage of milling ore that will be required after the mill enlargement is completed, the payroll last month was unusually heavy, reaching a total of $40,923.95.

Mill Operation.

Total ore milled		5373 tons
Daily average (30 days)		179.10 tons
Daily average (running time)		187.32 tons
Average value per ton of ore milled	$18.51	
Average value of tails	2.25	
Recovery, per ton	16.259	
Total recovery on 5373 tons at $16.259	87,359.61	
Average concentrate value per ton	340.00	
Tons of concentrates produced at $340		257.00 tons

Extraction was lower than usual, owing to cold weather, the boiler ordered for heating of solutions being 50 days late on delivery.

Mill Expansion.

The work of enlarging the mill to handle 400 tons of ore daily is proceeding rapidly and satisfactorily. During the month all necessary machinery and motors were purchased and prompt delivery of the same is promised. The addition to the building is nearly completed and it is hoped and expected that the new equipment will be in place and ready for service early in the new year.

Litigation.

The company has instituted suit in the federal court against the Randsburg Silver Mining (Coyote) Company to determine the ownership of certain ore ledges within the surface lines of the latter company. Pending the hearing of this suit, however, the Coyote Company has been advised that it is not the purpose of the California Rand Silver, Inc., to seek to interfere with ore shipments from the Coyote ground, and it is presumed that that company will continue to market any shipping ore it now has or may develop within its lines.

Financial.

During November, net proceeds from the sale of ore and concentrates amounted to $173,750.14. After paying this dividend of $25,600, the company has a balance of $358,237.17.

Massen Silver Mines. This property is located three miles northeast of Barstow and one mile southeast of the old Waterman Mine. It consists of 5 claims, containing two veins which course northwest and southeast. Average width of the vein 4 to 4½ feet. Locations are known as Silver Nos. 1, 2, 3, 4, and 5.

On claim Silver No. 3, an incline shaft has been sunk to a depth of 140 feet. There is also a tunnel 30 feet long on this vien in Silver No. 3, the ore from which runs 4½ to 12 ounces silver and 40 cents to 80 cents gold per ton.

On Silver No. 2, an incline shaft has been started and is now down 10 feet. Vein dips 65 degrees to the northeast. Bottom of the shaft shows 5 feet of ore, assaying from 4 to 8 ounces silver and 40 cents to 80 cents in gold.

J. H. Massen, owner.

Randsburg Silver Mining Co. (Coyote.) Owing to the suit filed by the California Rand Silver, Inc., against the Coyote for shipping ore from the Coyote claim, all shipments have been suspended for the time being. The hearing has been set for December 18th.

All other development in the shafts on the Foster group and in the newly acquired Santa Fe ground is being vigorously pushed.

J. W. Kelly, president; J. A. Carpenter, superintendent. Office, Hibernian Building, Los Angeles, California.

OIL FIELD DEVELOPMENT OPERATIONS.

R. E. Collom, State Oil and Gas Supervisor.

From November 11, 1922, to and including December 9, 1922, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Fresno Associated Oil & Gas Co.	23	14	20	1	
KERN COUNTY:					
Union Oil Co.	26	30	24	Elk Hills 8	Elk Hills
Balboa Oil Co.	24	31	23	18	Midway
Balboa Oil Co.	24	31	23	7	Midway
C. C. M. O. Co.	26	31	22	28	Midway
Honolulu Cons. Oil Co.	6	32	24	16	Midway
Honolulu Cons. Oil Co.	6	32	24	18	Midway
Honolulu Cons. Oil Co.	6	32	24	17	Midway
Midland Oilfields Co., Ltd.	24	31	23	3	Midway
North American Oil Cons.	2	32	23	20	Midway
Pacific Oil Co.	35	31	23	10	Midway
Pacific Oil Co.	15	32	24	91	Midway
Pacific Oil Co.	7	32	24	71	Midway
Pacific Oil Co.	5	32	24	36	Midway
Pacific Oil Co.	25	31	23	36	Midway
P. Welch	18	11	23	9-G	Sunset
Big Eight Oil Co.	2	27	18	1	
KINGS COUNTY:					
Sagebrush Oil & Gas Co.	18	22	19	Lakeshore 2	
LOS ANGELES COUNTY:					
Standard Oil Co.	17	3	10	M-C 97	Coyote Hills
Anson & Differding	30	4	12	1	Long Beach
Atlantic Petroleum Syndicate	19	4	12	Maltby 1	Long Beach
Barham Oil Co.	19	4	12	1-A	Long Beach
Bolsa Chica Oil Co.	30	4	12	3	Long Beach
Bush-Voorhis Oil Co.	19	4	12	9	Long Beach
Capitol Oil Co.	19	4	12	2	Long Beach
Cassaday Oil Corp.	19	4	12	1	Long Beach
Crown Syndicate	19	4	12	Clark-King 1	Long Beach
D'Angelo Oil Co.	19	4	12	1	Long Beach
Davis-MacMillan Syndicate	29	4	12	2	Long Beach
Downs-Fleming	19	4	12	1	Long Beach
General Petroleum Corp.	20	4	12	Jasper 1	Long Beach
General Petroleum Corp.	19	4	12	Black & Drake 2	Long Beach
Harmony Dobyns Oil Syndicate	30	4	12	1	Long Beach
Harmony Taylor Oil Syndicate	30	4	12	1	Long Beach
D. D. Huddleston	13	4	12	3	Long Beach
Marine Oil Corp.	20	4	12	9	Long Beach
E. J. Miley	18	4	12	3	Long Beach
Mission Bell Oil Syndicate	19	4	12	1	Long Beach
P. K. Co.	19	4	12	1	Long Beach
Painted Hills Oil Association	19	4	12	2	Long Beach
H. H. Patton	19	4	12	1	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Davidson 50-50 2	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Fields 2	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Harlow 5	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Davidson 3	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Harlow 6	Long Beach
Petroleum Midway Co., Ltd.	29	4	12	McDavid 2	Long Beach
Rice Ranch Oil Co.	19	4	12	Hoffman 1	Long Beach
Rice Ranch Oil Co.	19	4	12	Augustine 1	Long Beach
Shell Co.	29	4	12	Andrews 3	Long Beach
Shell Co.	29	4	12	Nesa 3	Long Beach
Shell Co.	29	4	12	Stakemiller 2	Long Beach
Shell Co.	29	4	12	Wilbur Com. 3	Long Beach
Shirley Lease Co.	19	4	12	1	Long Beach
Superior Oil Co.	29	4	12	Crew 1-A	Long Beach
Trojan Oil Co.	19	4	12	1	Long Beach
West Continental Oil Co.	30	4	12	1	Long Beach
Wigle & McBride	19	4	12	Garnett 1	Long Beach
Kenneth R. Woolley	29	4	12	Leonard 4	Long Beach
Kenneth R. Woolley	29	4	12	Leonard 6	Long Beach
Fullerton Oil Co.	8	4	14	Waddell 2	Redondo
Standard Oil Co.	5	4	14	Kirk Com. 2	Redondo
Union Oil Co.	5	4	14	Francis 2	Redondo
Petaluma Midway Co., Ltd.	29	3	9	Yarnell 16	Richfield
Union Oil Co.	28	3	9	Shanklin 3	Richfield
Brady Eight Wells Syndicate	8	3	11	1	Santa Fe Springs
General Petroleum Corp.	6	3	11	Santa Fe 77-A	Santa Fe Springs

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont'd.:					
General Petroleum Corp.	6	3	11	Springs 5	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 10	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 8	Santa Fe Springs
General Petroleum Corp.	6	3	11	Springs 3	Santa Fe Springs
General Petroleum Corp.	6	3	11	Springs 6	Santa Fe Springs
General Petroleum Corp.	6	3	11	Springs 7	Santa Fe Springs
General Petroleum Corp.	6	3	11	Springs 8	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 9	Santa Fe Springs
General Petroleum Corp.	6	3	11	Santa Fe 79-B	Santa Fe Springs
Globe Petroleum Corp.	6	3	11	3	Santa Fe Springs
Hopkins & Howland	6	3	11	Baker 1	Santa Fe Springs
Oscar R. Howard	5	3	11	Bell 2	Santa Fe Springs
Industrial Oil Syndicate No. 2	7	3	11	1	Santa Fe Springs
A. L. Irish	5	3	11	2	Santa Fe Springs
A. L. Irish	5	3	11	3	Santa Fe Springs
Kirkpatrick Syndicate No. 2	6	3	11	Wilshire Gill 1	Santa Fe Springs
K. Lundeen-M. E. Lee	6	3	11	1	Santa Fe Springs
Pacific States Oil Co.	6	3	11	1	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 4	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 5	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 2	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Mattern Three 3	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 3	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 7	Santa Fe Springs
Petroleum Midway Co., Ltd.	6	3	11	Patterson 6	Santa Fe Springs
Petroleum Midway Co., Ltd.	31	2	11	Mattern One 1	Santa Fe Springs
Petroleum Midway Co., Ltd.	31	2	11	Mattern Two 2	Santa Fe Springs
Producers Holding Co.	7	3	11	Tri-Field 1	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Com. 6	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Com. 7	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Com. 5	Santa Fe Springs
Standard Oil Co.	5	3	11	S. Whittier Com. 8	Santa Fe Springs
Standard Oil Co.	5	3	11	S. Whittier Com. 10	Santa Fe Springs
R. L. Hinckley	33	4	23		
Standard Oil Co.	32	2	11	Sanchez 1-A	Santa Fe Springs
Standard Oil Co.	6	3	11	Johnson 2	Santa Fe Springs
Standard Oil Co.	5	3	11	S. Whittier Com. 9	Santa Fe Springs
Star Petroleum Co.	6	3	11	Star 2	Santa Fe Springs
Union Oil Co.	6	3	11	Bell 17	Santa Fe Springs
White Star Oil Syndicate	6	3	11	2	Santa Fe Springs
White Star Oil Syndicate	6	3	11	3	Santa Fe Springs
Wilshire Oil Co.	7	3	11	Surbeck 1	Santa Fe Springs
E. G. Lewis	36	4	14	Palos Verdes 1	------------------
Oak Ridge Oil Co.	22	2	12	Rossi 1	------------------
Union Oil Co.	21	1	14	Weston 1	------------------
ORANGE COUNTY:					
Associated Oil Co.	2	6	11	Hunt. Bch. 8	Huntington Bch.
Auburn Oil Co.	35	5	11	1	Huntington Bch.
Holly Oil Co.	35	5	11	4	Huntington Bch.
Huntington Central Oil Co.	2	6	11	3	Huntington Bch.
O'Donnell Syndicate	34	5	11	3	Huntington Bch.
Petroleum Midway Co., Ltd.	35	5	11	Paige 1	Huntington Bch.
Petroleum Midway Co., Ltd.	35	5	11	Towers 5	Huntington Bch.
Petroleum Midway Co., Ltd.	2	6	11	Columbia One 2	Huntington Bch.
The Petroleum Co.	2	6	11	Wilson 2	Huntington Bch.
Standard Oil Co.	34	5	11	Hunt. A. 20	Huntington Bch.
Standard Oil Co.	2	6	11	Hunt. B. 17	Huntington Bch.
Union Oil Co.	34	5	11	Brooks 7	Huntington Bch.
Union Oil Co.	34	5	11	Brooks 6	Huntington Bch.
Union Oil Co.	35	5	11	Copeland 16	Huntington Bch.
White Behr Petroleum Syndicate	35	5	11	Jackie Coogan 2	Huntington Bch.
Portland Petroleum Corporation	5	6	10	Borchard 1	------------------
Portland Petroleum Corporation	5	6	10	Adlai 1	------------------
SAN LUIS OBISPO COUNTY:					
Alberta Oil Co.	Rauschenplet Ranch Rancho Corral de Piedra			Alberta 1	Arroyo Grande

OIL FIELD DEVELOPMENT OPERATIONS—Concluded.

Company	Sec.	Twp.	Range	Well No.	Field
SANTA BARBARA COUNTY:					
Shell Co. (U. D.)	32	9	33	Carega 93	Santa Maria
Standard Oil Co.	Rancho de Jo	San C nata --	arlos --------	Buell 1-C	------------------
VENTURA COUNTY:					
Montebello Oil Co.	4	3	19	Shiells 127	Bardsdale
J. N. Bissell	33	2	20	2	Conejo
Schell & Jennings	32	4	18	4	Piru
Dixie National Oil Co.	5	4	19	3	Sespe
R. L. Hinckley	33	4	23	14	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff containing much information that will add to the permanent value of the Monthly Chapter are included in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

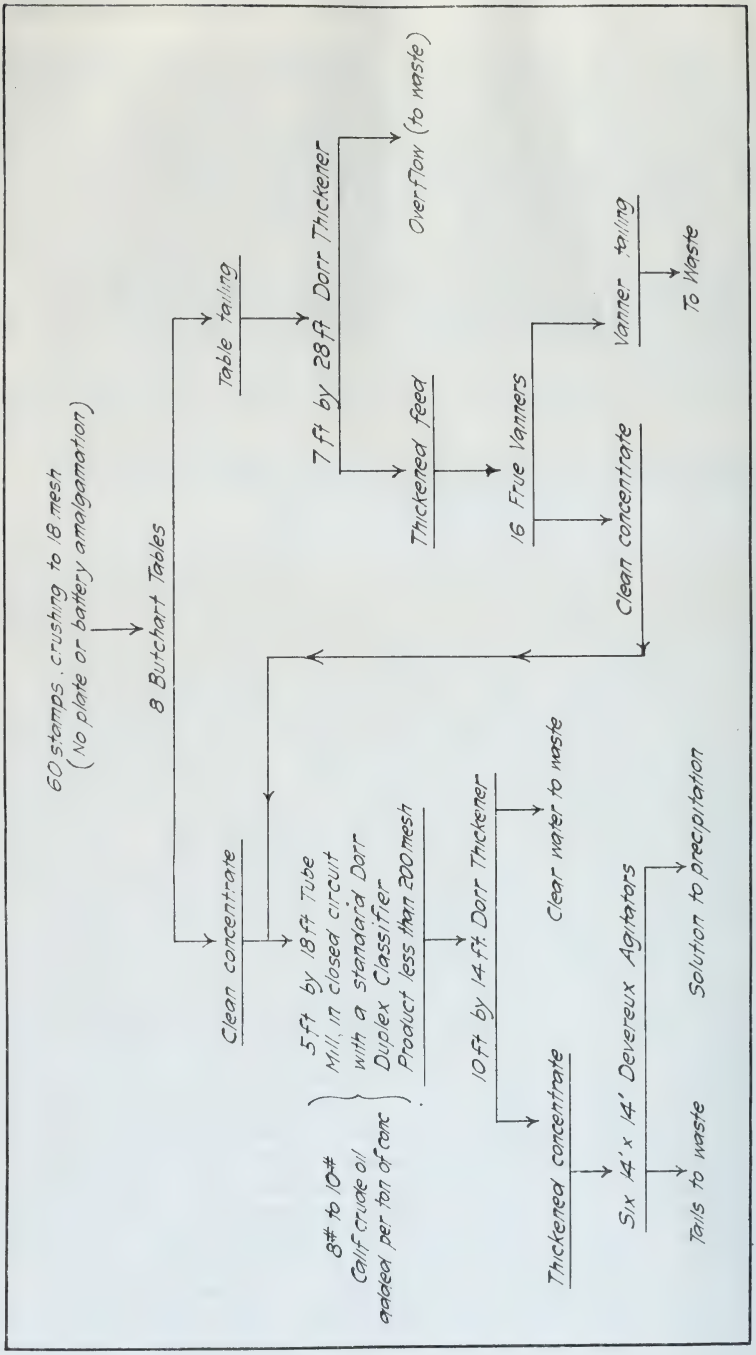
ORE TREATMENT AT THE BELMONT SHAWMUT MINE, TUOLUMNE COUNTY.

By C. A. Logan.

This mine is at present the only producer on the Mother Lode in Tuolumne County. The ore is coming from depths of about 2600 to 2900 feet on the dip of the vein. It is principally sulphide ore, free gold being subordinate. Four types of ore have been mined, known at the mine for convenience as banded quartz, impregnated schist, dark and light sulphide ores. Pyrite is the chief sulphide and the ore is characterized by dolomite and to a less extent by lime. The percentage of pyrite is variable but rather high. The pay in the old upper levels was largely in free gold. The first of the dolomite sulphide was said to have been encountered on the 17th level, and it became important from there down. The immediate footwall is a basic dike, and limestone is prominent in the Mariposa rocks near the periphery of the dike. The geology of the mine will be treated in detail in the Mother Lode report.

Numerous methods of treatment have been tried on the ores from this mine. Originally there was the regulation stamp milling with plate amalgamation. Then a chlorination plant was installed and used until the Belmont Mining Company bought the mine. They installed Jones Belmont flotation cells and made two grades of concentrates, one on the tables and the other with the flotation cells. These concentrates were shipped at first, but the grade of them and the costs of shipment and treatment led to experimenting. In the course of these experiments, it was found that for some reason the oil floated concentrate responded better to cyanide treatment than the straight table concentrate. It was assumed that the oil used was responsible for this. It was also found that while flotation gave satisfactory results from the standpoint of recovery, it was more expensive than results justified. Flotation has therefore been laid aside at present and the flow-sheet outlined below has been put in effect. O. McCreaney, general superintendent, states it is giving good results. Under this plan, eight to ten pounds of California crude oil are added for each ton of concentrate when regrinding preliminary to cyanide treatment. This gives the hydrocarbon content which is assumed to promote recovery. The concentrators alone are relied upon to recover the free gold.

The experience of this company with flotation confirms the results had some years ago at the Dutch-App Mines by William J. Loring, in treating Mother Lode ore. The average grade of concentrate found along this lode is such as to require as economical treatment as possible. Freight and smelter charges have lately been so high that local recovery of the gold is desirable if possible. On the other hand, Mother Lode ores are generally amenable to simple processes of concentration and treatment. In this connection, it may be of interest to compare the flow-sheet following, with the method of milling a low grade schist sulphide ore as practised at the Treasure Mine on the Mother Lode in Amador County, and described in Report XVII of the State Mineralogist, 1920.


60 stamps, crushing to 18 mesh
(No plate or battery amalgamation)
8 Butchart Tables
Table tailing
7 ft by 28 ft Dorr Thickener
Overflow (to waste)
Thickened feed
16 Frue Vanners
Vanner tailing
To Waste
Clean concentrate
Clean concentrate
5 ft by 18 ft Tube Mill, in closed circuit with a standard Dorr Duplex Classifier
8# to 10# Calif crude oil added per ton of conc
Product less than 200 mesh
10 ft by 14 ft Dorr Thickener
Clear water to waste
Thickened concentrate
Six 14' x 14' Devereux Agitators
Solution to precipitation
Tails to waste

Flow-sheet at Belmont Shawmut Mill, Tuolumne County.

By courtesy of the company.

±18 1920

BIBLIOGRAPHY OF LIMESTONE DEPOSITS IN CALIFORNIA.

By C. McK. Laizure.

The following compilation of references to the limestone deposits of California has been prepared with the idea of offering a means of ready reference to the descriptions of deposits reported upon in the various publications of the State Mining Bureau. No attempt has been made to include references in other works, and even in the Bureau publications those merely listing laboratory specimens or describing the manufacture of lime and its uses, or referring to the purely geological phase or mode or origin, are omitted.

References to marble, dolomitic limestone, and dolomite deposits are included, however, and it is believed that practically all deposits of commercial importance, as well as many of unknown extent and value, are mentioned.

The bibliography has been arranged in two parts. The first section gives the volume and page reference by counties, alphabetically arranged so that the limestone deposits in any particular locality may be found readily under the heading of the proper county. In the second section the page reference is given for all limestone deposits described in each particular volume, regardless of where the deposit occurs in the State. The latter will be found more convenient than the regular volume indices in which the references are segregated by counties.

The bibliography is confined to the Bureau publications, all of which may be consulted at the Bureau offices in San Francisco, Los Angeles, Bakersfield, Taft, Coalinga, Santa Maria, Santa Paula, Redding, and Auburn, as well as in many public libraries. Publications not out of print may be purchased at any of the above offices, or may be obtained without charge, if for free distribution, as the case may be.

References by Counties.

Alameda County.
- Report VIII, pp. 35, 104.
- Report XIII, p. 627.
- Report XVII, p. 22, 23.
- Bulletin 38, p. 64.

Alpine County.
- Report VIII, p. 39.

Amador County.
- Report IV, p. 108.
- Report VI, pp. 29, 95, 107.
- Report VIII, p. 104.
- Report XII, p. 391.
- Report XIV, pp. 52, 53.
- Bulletin 38, pp. 64, 96, 97.

Butte County.
- Report IV, p. 108.
- Report VI, pp. 29, 95, 96.
- Report VIII, p. 116.
- Report XI, p. 157.
- Bulletin 38, pp. 65, 98.

Calaveras County.
- Report IV, p. 109.
- Report VI, pp. 29, 95, 96, 107.
- Report VIII, p. 156.
- Report XII, p. 391.
- Report XIII, p. 627.
- Report XIV, pp. 54, 128, 129.
- Bulletin 38, pp. 65, 66, 98, 99.

Colusa County.
- Report XI, p. 188.
- Report XIV, p. 179.
- Bulletin 38, p. 66.

Contra Costa County.
- Report VI, p. 27.
- Report VIII, pp. 161, 162.
- Report IX, p. 310.
- Report XIII, p. 628.
- Report XVII, p. 55.
- Bulletin 38, pp. 66, 67.

El Dorado County.
- Report IV, p. 109.
- Report VI, pp. 96, 97.
- Report VIII, pp. 164, 200.
- Report XII, p. 391.
- Report XIII, p. 628.
- Report XV, p. 304.

References by Counties—Continued.

El Dorado County—*Concluded.*
- Report XVII, p. 432.
- Bulletin 38, pp. 67, 68.
- Preliminary Report No. 6, p. 20.
- Preliminary Report No. 8, p. 49.

Fresno County.
- Report VIII, p. 208.
- Report X. p. 185.
- Report XIII, p. 628.
- Report XIV, p. 452.
- Bulletin 38, p. 68.

Glenn County.
- Report XIV, p. 198.
- Bulletin 38, p. 99.

Humboldt County.
- Report IV, p. 109.
- Report VI, pp. 23, 97.
- Report VIII, p. 216.
- Report XIV, pp. 374, 393, 394.

Imperial County.
- Report XVII, p. 268.

Inyo County.
- Report IV, p. 109.
- Report VI, pp. 25, 26, 27, 28, 29, 96, 97, 107.
- Report VIII, pp. 225-248, 250-285.
- Report X, pp. 215, 216, 217, 218.
- Report XII, p. 392.
- Report XIII, p. 628.
- Bulletin 38, pp. 99, 100.

Kern County.
- Report IV, p. 109.
- Report VI, pp. 23, 29, 96, 97.
- Report VIII, pp. 310, 311, 316, 318, 323.
- Report XIII, p. 628.
- Report XIV, pp. 479, 516, 517, 518. 520.
- Report XVII, p. 312.
- Bulletin 38, pp. 69, 72, 100.
- Preliminary Report No. 6, p. 35.
- Preliminary Report No. 8, pp. 52, 60.

Lake County.
- Report XII, p. 392.
- Report XIV, p. 206.

Lassen County.
- Report VI, p. 28, 96.

Los Angeles County.
- Report IV, p. 110.
- Report VI, pp. 27, 97, 107.
- Report VII, pp. 212, 213.
- Report VIII, pp. 339, 342.
- Report IX, pp. 200, 310.
- Report X, p. 282.
- Report XIII, p. 629.
- Report XV, p. 486.

Madera County.
- Report XII, p. 392.
- Report XIII, p. 629.

Mariposa County.
- Report VI, p. 96.
- Report XIII, p. 629.
- Report XIV, p. 601.
- Report XVIII, p. 9.
- Bulletin 38, p. 100.

Mendocino County.
- Report VI, p. 107.

Mono County.
- Report VI, pp. 28, 96.
- Report XIII, p. 629.

Monterey County.
- Report IV, p. 110.
- Report VI, pp. 29, 97.
- Report VIII, p. 410.
- Report XI, p. 260.
- Report XII, p. 392.
- Report XIII, p. 629.
- Report XV, p. 606.
- Bulletin 38, pp. 72, 73.

Napa County.
- Report VI, p. 107.
- Report XIII, p. 629.
- Report XIV, p. 271.

Nevada County.
- Report IV, p. 110.
- Report VI, pp. 29, 97.
- Report XI, p. 312.
- Report XII, p. 393.
- Report on Nevada County, p. 59.
- Bulletin 38, pp. 73, 100.

Orange County.
- Report XV, p. 520.
- Bulletin 38, p. 73, 74.

Placer County.
- Report IV, p. 110.
- Report VI, pp. 28, 29, 96, 97.
- Report XV, p. 390.
- Report XVII, pp. 453, 454.
- Bulletin 38, pp. 74, 101.

Plumas County.
- Report IV, p. 111.
- Report VI, pp. 97, 107.
- Report on Plumas County, pp. 21, 24, 40, 42, 45, 178, 179.
- Bulletin 38, p. 75, 101.
- Preliminary Report No. 8, p. 57.

Riverside County.
- Report XII, p. 393.
- Report XV, p. 553.
- Bulletin 38, pp. 75, 76, 102.
- Preliminary Report No. 6, p. 35.

References by Counties—Continued.

San Benito County.
Report VI, pp. 28, 29.
Report VIII, p. 488.
Report XII, p. 393.
Report XIII, p. 629.
Report XV, pp. 626, 633, 640.
Report XVIII, pp. 217, 218.
Bulletin 38, p. 76.

San Bernardino County.
Report IV, p. 111.
Report VI, pp. 27, 28, 96, 97, 107.
Report VIII, p. 504.
Report IX, pp. 215, 225, 310.
Report X, p. 528.
Report XI, pp. 363, 364.
Report XII, p. 394.
Report XIII, p. 630.
Report XV, pp. 871, 862.
Report XVII, p. 353.
Report XVIII, pp. 115, 148.
Bulletin 38, pp. 77, 78, 79.
Preliminary Report No. 6, p. 35.

San Diego County.
Report VI, pp. 96, 102, 103, 104, 105, 106.
Report VIII, p. 526.
Report IX, pp. 151, 309.
Report XIV, pp. 673, 684, 685.
Report XVII, p. 378.
Bulletin 38, p. 107.

San Francisco County.
Report VI, pp. 28, 96.

San Joaquin County.
Bulletin 38, p. 79.

San Luis Obispo County.
Report IV, p. 112.
Report VI, pp. 27, 28, 97, 107.
Report VIII, p. 532.
Report X, p. 584.
Report XII, p. 394.
Report XV, p. 689.
Bulletin 38, pp. 79, 80.

San Mateo County.
Report VIII, p. 534.
Report XVII, p. 174.

Santa Barbara County.
Report VIII, p. 538.
Report IX, p. 310.
Report XV, p. 739.
Report XVII, p. 388.
Bulletin 38, pp. 80, 81, 82.

Santa Clara County.
Report VI, pp. 27, 96.
Report VIII, pp. 543, 544.
Report IX, pp. 52, 53.
Report X, p. 619.
Report XII, p. 394.
Report XIII, p. 630.
Report XVII, pp. 184, 185, 186.
Bulletin 38, pp. 82, 83.

Santa Cruz County.
Report IV, p. 112.
Report VI, pp. 28, 96, 98.
Report VIII, pp. 554, 555.
Report X, p. 626.
Report XII, p. 394.
Report XIII, p. 631.
Report XVII, pp. 237, 238, 239.
Bulletin 38, pp. 83, 84, 85, 86, 87, 88.

Shasta County.
Report IV, p. 112.
Report VI, p. 98.
Report VIII, p. 572.
Report X, p. 627.
Report XI, pp. 35, 37, 48.
Report XII, p. 395.
Report XIII, p. 632.
Report XVIII, p.——.
Bulletin 38, pp. 88, 89, 90, 91, 107.
Preliminary Report No. 6, p. 11.
Preliminary Report No. 8, p. 48.

Sierra County.
Report on Sierra County, p. 26.
Bulletin 38, p. 92.

Siskiyou County.
Report VI, pp. 29, 96.
Report XIII, p. 632.
Bulletin 38, pp. 92, 93, 107, 108.

Solano County.
Report VIII, p. 631.
Report X, pp. 669, 670.
Report XI, p. 191.
Report XII, p. 395.
Report XIII, p. 632.
Report XIV, p. 309.
Bulletin 38, p. 61, 108.

Sonoma County.
Report VIII, p. 633.
Report XI, p. 463.
Report XII, p. 396.
Report XIII, p. 633.
Report XIV, p. 323.
Bulletin 38, p. 93, 94.

Sutter County.
Report XV, p. 256.
Report XVII, p. 256.

Trinity County.
Report XIII, p. 633.
Bulletin 38, p. 94.

References by Counties—Concluded.

Tulare County.
Report VIII, pp. 644, 647, 648.
Report XIII, p. 633.
Report XV, p. 918.
Report XVII, p. 259.
Report XVIII. p.———.
Bulletin 38, pp. 94, 95, 108.

Tuolumne County.
Report IV, pp. 112, 113, 114.
Report VI, pp. 29, 98.
Report VIII, p. 675.
Report X, p. 735.
Report XI, p. 506.
Report XII, p. 396.
Report XIII, p. 633.
Report XIV, pp. 132, 168, 169.
Report XVII, p. 487.
Bulletin 38, pp. 95, 108, 110.
Preliminary Report No. 6, p. 20.
Preliminary Report No. 8, p. 49.

Ventura County.
Report XV, p. 761.

Yolo County.
Report XIV, p. 368.

Yuba County.
Bulletin 38, p. 110.

The only counties in which there are no limestone deposits referred to in the Bureau publications are: Del Norte, Kings, Marin, Merced, Modoc, Sacramento, Stanislaus, and Tehama.

However, undeveloped deposits of limestone are known in Merced County.

References by Publications.

Report IV. 1884. Pages 108, 109, 110, 111, 112, 113, 114.

Report VI. 1885–1886. Pages 23, 25, 26, 27, 28, 29, 95, 96, 97, 98, 107.

Report VII. 1886–1887. Pages 212, 213.

Report VIII. 1887–1888. Pages 35, 39, 104, 116, 156, 161, 162, 164, 200, 208, 216, 225–248, 250–285, 310, 311, 316, 318, 323, 339, 342, 410, 488, 504, 526, 532, 534, 538, 543, 544, 554, 555, 572, 631, 633, 644, 647, 648. 675, 680.

Report IX. 1888–1889. Pages 52, 53, 151, 200, 215, 225, 309, 310.

Report X. 1889–1890. Pages 185, 215, 216, 217, 218, 282, 528, 584, 619, 626, 627, 669, 670, 735.

Report XI. 1891–1892. Pages 35, 37, 48, 157, 188, 191, 260, 312, 363, 364, 463, 506.

Report XII. 1893–1894. Pages 391, 392, 393, 394, 395, 396.

Report XIII. 1895–1896. Pages 627, 628, 629, 630, 631, 632, 633.

Report XIV. 1913–1914. Pages 52, 53, 54, 128, 129, 132, 168, 169, 198, 206, 271, 309, 323, 368, 374, 393, 394, 452, 479, 516, 517, 518, 520, 601, 673, 684, 685.

Report XV. 1915–1916. Pages 256, 304, 390, 486, 520, 553, 606, 626, 633, 640, 689, 739, 761, 862, 871, 918.

Report XVII. 1920. Pages 22, 23, 55, 174, 184, 185, 186, 237, 238, 239, 256, 259, 268, 312, 353, 378, 388, 432, 453, 454, 487.

Report XVIII. 1922. Pages 9, 115, 148, 217, 218.

Bulletin No. 38. 1906. Pages 61, 64, 65, 66, 67, 68, 69, 72, 73, 74, 75, 76, 77, 78, 79, 80–102, 107, 108, 110.

Preliminary Report No. 6. 1919. Pages 11, 20, 35.

Preliminary Report No. 8. 1921. Pages 48, 49, 52, 57, 60.

SECRETARY'S OFFICE.

W. W. THAYER, Secretary.

The California State Mining Bureau was created April 16, 1880, by legislative act. In March, 1893, the original act was repealed and an amended act approved and passed by the legislative body. Again on June 16, 1913, a new Mining Bureau Act was approved which became effective August 10, 1913, repealing all former acts, and forming the basic law under which the Bureau now functions.

It is doubtless true that both the mining and lay public have not in the past always recognized the part played by the Bureau in the development of the state's mineral resources. Innumerable inquiries regarding them, originating within and without its borders and in foreign countries, have been answered with ultimate results reflected by a consistent growth in the value of the state's mineral output since the records of production were first compiled by the Bureau in 1887.

It is believed that a better understanding of the economic position occupied by the Bureau will be imparted to the public, whose funds support it, by embodying in the Monthly Chapter a review of the executive activities.

The responsibility for the coordination of effort of each department, to the end that the utmost efficiency may be maintained with the limited and variable appropriations accorded the Bureau by successive legislatures, rests upon the office of secretary.

Activities referable to that office, such as reports of new maps and publications issued, amount of mail handled, changes and enlargements in offices, changes in personnel of the staff, property and equipment, financial statements, etc., are therefore included herein.

New Publications.

During the month the following Bureau Publications have been made available for distribution:

Summary of Operations, California Oil Fields, September, 1922, Vol. 8, No. 3.
Mining in California, September, 1922 (Monthly), Vol. 18, No. 9.
Oil Field Map, No. 20, Long Beach, revised to October 7, 1922.

Distribution of Publications.

The Bureau's publications are constantly in demand, requests for copies coming from all over the United States and foreign countries.

Publications were distributed during the month as follows:

Publications	Number distributed
Report XIV, State Mineralogist	4
Report XV, State Mineralogist	3
Report XVII, State Mineralogist	1
Mines and Mineral Resources of Butte, etc.	1
Mines and Mineral Resources of Del Norte, etc.	15
Mines and Mineral Resources of Fresno, etc.	3
Mines and Mineral Resources of Imperial, etc.	2
Mines and Mineral Resources of Alpine, etc.	7
Mines and Mineral Resources of El Dorado, etc.	2
Mines and Mineral Resources of Los Angeles, etc.	3
Mines and Mineral Resources of Monterey, etc.	1
Mines and Mineral Resources of San Bernardino, etc.	4
Mines and Mineral Resources of Nevada County	6

Publications	Number distributed
Mines and Mineral Resources of Plumas County	6
Mines and Mineral Resources of Sierra County	3
Bulletin No. 6, California Gold Mill Practices	5
Bulletin No. 37, Gems, Jewelers' Materials, Ornamental Stones of California	1
Bulletin No. 50, Copper Resources of California (Revised)	1
Bulletin No. 72, Geologic Formations of California	10
Bulletin No. 75, U. S. and California Mining Laws	50
Bulletin No. 76, Manganese and Chromium in California	2
Bulletin No. 78, Quicksilver Resources of California	3
Bulletin No. 85, Platinum Resources of California	8
Bulletin No. 89, Petroleum Resources of California, with special reference to unproved areas	37
Bulletin No. 90, California Mineral Production for 1920, with County Maps	60
Mining in California (Monthly), Vol. 18, No. 8, August, 1922	150
Mining in California (Monthly), Vol. 18, No. 9, September, 1922	3,000
Summary of Operations, California Oil Fields (Monthly) Vol. 8, No. 2, August, 1922	250
County Maps and Registers of Mines	9
Copper Deposit Map	1
Minaret Map	1
Tuolumne Mineral Map	1
Geological Map of California, mounted	12
Oil Field Maps	254
Maps accompanying Bulletin 89	40

Mails and Files.

The Bureau maintains in addition to its correspondence file a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the month 850 letters were received and answered. They are practically all requests for information and the inquiries cover all phases of prospecting, mining and developing mineral deposits, reduction of crude minerals and marketing of refined products.

Drafting.

The Bureau maintains an up-to-date drafting department, where topographic and geological maps, tracings, oil well logs, and oil field maps are prepared.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Statistician and Curator.

STATISTICS.

The detailed figures and data relative to the mineral production of California for the calendar year, 1921, are shown in the preceding issues of 'Mining in California,' for the months of April-November (inclusive). At the close of the current year, 1922, preliminary data will be assembled and an estimate made of the approximate output of this year; which estimate will be published in the forthcoming January issue.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections located in North America; and contains not only one or more samples of most of the known minerals found in California, but many specimens from other states and foreign countries as well.

Aside from its purely educational features, the Museum daily attracts throngs of tourists and travelers, and furnishes visual evidence of the immense mineral resources of California. The State Mining Bureau supplies a collection of forty typical minerals and ores, appropriately labeled, to any public school in the state upon request.

Mineral specimens suitable for exhibit purposes are solicited and their donation will be appreciated by the State Mining Bureau, as well as by those who utilize the facilities of the collection.

During the past month a total of 468 visitors signed their names to the Museum register, and in addition there are many others daily who fail to take note of our request for their signatures.

Among the specimens received recently, and catalogued for the Museum, are the following:

19625. Facsimile of *Gold Nugget* found in Sunnyside Mine, McCray Ridge Channel, near Johnsville, Plumas County, Cal. Value approximately $3,200. By Mr. Kelsey, Quincy.

19627. Facsimile of *Gold Bars* (4), representing average monthly yield (1920–1921) of Carson Hill Gold Mines Co., Calaveras County, Cal. Approximate value $25,000 each, or $100,000 per month. By courtesy of the company, Wm. J. Loring, President.

19653. *Pollucite* (hydrous caesium-aluminum silicate). From Andover, Maine, by Merle Randall, Berkeley.

19655. *Halotrichite* (hydrous ferrous aluminum sulphate). From Wallace, Idaho, by R. G. Cotter, Oakland.

19659. *Allanite or Orthite* ('Cerium Epidote,' a complex Ca, Fe, Al silicate with cerium metals, Ce, Di, La). From pegmatite dike on D. F. Gassenberger Ranch, 5½ miles southeast of Lindcove, Cal., by Gordon Surr, Porterville.

19660. *Alexandrolite* (hydrous Al, Cr, Fe, silicate), from alteration of Avalite. A chromiferous 'clay' in green crusts on decomposed serpentine. From 2 miles southeast of Lindsay, Cal. (Not previously reported in U. S.) By Gordon Surr, Porterville.

19661. *Alexandrolite* (hydrous Al, Cr, Fe, silicate), from alteration of *Avalite.* A chromiferous 'clay,' in green crusts on decomposed serpentine. From 2 miles southeast of Lindsay, Cal., by John Melhase, San Francisco.

19662. *Heterogenite* (hydrous cobalt oxide). From Goodsprings, Nevada, by John Melhase, San Francisco.

19663. *Conichalcite* (hydrous Cu, Ca, arsenate), with Malachite (copper carbonate). From Simon Lead mine, near Mina, Nevada, by John Melhase, San Francisco.

19665. Placer *Gold.* From Highland Chief Mine, near Magalia, Butte County, Cal., by Carl A. Phelps and M. H. Ballou, Magalia.

19666. *Andesite.* Lava cap covering Tertiary auriferous gravel channels. From one mile north of Volcano, Amador County, Cal., by Walter W. Bradley, Berkeley.

19670. *Gold*-bearing quartz with pyrite. Stated to assay $20 gold per ton; vein 2½′–3′ wide. From Bricktop mine, 2 miles east of Groveland, Tuolumne County, Cal., by W. H. Campbell, San Francisco.

19671. *Celestite* (strontium sulphate). Crystallized and massive specimens, one showing fine example of perfect cleavage. From Bowling Green, Ohio, by E. L. Moseley, Bowling Green.

19672. *Pyrargyrite* (silver antimonial sulphide). 'Dark ruby silver ore.' From Great Eastern R. R. Dist., Nevada, 1868, by E. L. Moseley, Bowling Green, O.

19673. *Stephanite* crystals, and *Pyrargyrite* (silver antimonial sulphides). From Lander Hill, Austin, Nevada (Univ. of Mich., No. 6054), by E. L. Moseley, Bowling Green, O.

19674. *Halite* (sodium chloride), 'Rock Salt'. From 1000 ft. depth in salt shaft at Oakwood, south of Detroit, Michigan, by E. L. Moseley, Bowling Green, O.

19675. Sylvania *Sandstone*; nearly 100 per cent quartz. Friable. From 7 miles northwest of Monroe, Mich. Stated to contain over 40,000 grains per gram. Used by National Silica Co. for making plate glass. By E. L. Moseley, Bowling Green, O.

19676. *Gypsum* (hydrous calcium sulphate). From Grand Rapids, Mich., by E. L. Moseley, Bowling Green, O.

19677. Calcareous *Tufa*, from west of Sandusky, Ohio, by E. L. Moseley, Bowling Green, O.

19678. Placer *Gold.* From Feather Forks placer mine, La Porte, Plumas County, Cal. (shaft and drift; with 12-ft. breast of gravel), by Feather Forks Gold Gravel Co., La Porte.

19679. *Gold,* in cemented gravel. Small gold nugget protects each corner of specimen from further wear. From Elephant Hydraulic mine, Volcano, Amador County, Cal., by J. W. Preston, Jr., San Francisco.

19680, 19681. *Meteorite,* with polished face showing Widmanstätten figures. Weight 46 pounds; *Meteorite,* weight 250 pounds. From Cañon Diablo, near Flagstaff, Ariz. Loaned by California Academy of Sciences, San Francisco.

19682. *Talc-schist.* E. D. Fitzsimons, Reedley, Cal.

19683. *Montmorillonite* (hydrous aluminum silicate, complex). Soap Rock, locally called 'Shoshonite'. Used commercially in soaps, and for filtration purposes similarly to fuller's earth. From Shoshone, Inyo County, Cal., by W. S. Baylis, The Filtrol Co., Los Angeles.

19684, 19685, 19686. *Pumice,* block form in several sizes; small size lumps, up to ¾-inch diameter, constituting 40 per cent of material mined. *Obsidian* gradating into *Pumiceous* phase. From Pumice Mountain, 30 miles east of Mt. Shasta, Siskiyou County, Cal., by W. A. T. Agard, San Francisco.

19687. *Carnotite* (hydrous potassium uranium vanadate). From Colorado, by Victor C. Alderson, Golden, Colorado.

19688. Free *Gold* in Quartz. From Newtown mine, 3½ miles due west from Nevada City, Nevada County, Cal., by Lester M. Dull, Nevada City.

19689. *Smithsonite* (zinc carbonate). Green; with some Calamine (zinc basic metasilicate). (3 pieces.) From Kelly mine, Kelly, New Mexico, by C. T. Brown, Socorro, N. Mex.

19690. *Limestone* in part dolomitic, containing some organic matter, showing concentric structure. An example of chemical deposition. From Mohawk Claim, Red Mountain district, Silver Peak Mountains, Esmeralda County, Nevada, by R. W. MacFarlane, El Paso.

19691. Pottery *Clay.* Used in making red earthenware flower-pots. From Coyote Creek, east of San Jose, Santa Clara County, Cal. By Walter W. Bradley, Berkeley.

19692. *Calcite* (calcium carbonate). Crystalline limestone. From El Abrigo Rancho, Santa Barbara County, Cal., by Marcus Simpson, El Abrigo Rancho, Santa Barbara.

19693, 19694, 19695. *Samarskite* (Fe, Ca, Ce, Y, niobate-tantalate, complex); *Monazite* (cerium group phosphate); *Bismutite* (basic bismuth carbonate). From 2 miles northwest of Petaca, Rio Arriba County, N. Mex., by Geo. M. Nelson, San Francisco.

19696, 19697. *Sillimanite* (aluminum silicate); *Kaolinite* (hydrous aluminum silicate), *Lithomarge* variety. From near Laws, Inyo County, Cal., near Nevada line, by E. S. Boalich, San Francisco.

19698. '*Gilsonite*' (Uintahite) natural asphalt. From American Hydrocarbon Co., Price, Utah, by Geo. M. Nelson, San Francisco.

19699. *Arsenopyrite* (iron sulph-arsenide) with *Scorodite* (hydrous ferric arsenate), an oxidation product of Arsenopyrite. From San Diego County, near Moreno Lake, by L. Hollis Gwyn, El Centro.

19700. Placer *Gold*. From the Highland Chief Mine, Magalia, Cal., by Carl A. Phelps, Magalia.

19701, 19702. *Mica Schist* and *Pyroxenite*. From Cedar Mountain, southeast of Livermore, Alameda County, Cal., by Ernest Mendenhall, Livermore.

19703. *Copper* ore (2 pieces). Sulphide and carbonate. From Pueblo district, Oregon (on Nevada line), by E. D. Farnham, Woodland, Cal.

19704, 19705. *Silver-gold* ore (oxidized), carrying pyrite; *Silver-gold* ore (unoxidized), carrying pyrite in quartz. From Great Sierra Cons. Silver Co. (Tioga Mine), Tioga mining district, Mono County, by Arthur R. Johnson, Oakland.

19706. *Gold* and *Platinum*. From panning in gravel bench, above Russian River. From Howell and Glatt placer mine, 2½ miles east of Hopland, Mendocino County, Cal., by Fred S. Howell, Petaluma.

19707. *Gold* ore with *Pyrite*. From Jessamine contact (formerly Connor) mine, Douglas County, Oregon, south of Roseburg, by Ed. Wells, San Francisco.

19708. *Barite* (barium sulphate). From Sisquoc, Santa Barbara County, Cal., by F. D. Gore, Santa Maria, Cal.

19709. *Scorodite* (hydrous ferric arsenate). From Wide Awake Mine, near Lovelock, Nevada, by Michael McCarthy, Lovelock.

19710. *Coal*. A good grade of *Lignite*. From a bed 7½ feet thick, San Benito Coal Co. mine, near Llanada, San Benito County, Cal., by A. N. Massey, San Francisco.

19711. *Quartz* crystal. Transparent, and sufficiently free of flaws to be suitable for gem purposes, by R. A. Paulsen, Bloomington, Cal.

19712. *Scheelite* (calcium tungstate). Crystals in metamorphic rock. From Upper Laurel Lake, Mono County, Cal., by Joseph Ward, Bishop.

19713. *Gold* in Calcite. From Grit Mine, Spanish Dry Diggings, El Dorado County, Cal., by Mr. Sweezy, Sacramento.

19714. *Aragonite* (calcium carbonate). 'Onyx Marble.' In part altered by paramorphism to *Calcite*. From Kessler Onyx Quarry, near Musick, San Luis Obispo County, Cal., by F. L. Firebaugh, Berkeley.

19715. *Magnesite* (magnesium carbonate). High-grade, showing characteristic conchoidal fracture. From Sierra magnesite group, Tulare County, Cal., by Sierra Magnesite Co., Porterville.

19716. *Limestone Marl*. Suitable for fertilizer purposes. From near Lindsay, Tulare County, Cal., by E. A. Orton, Lindsay.

19717. *Copper* ore (*Malachite* and *Azurite*, copper carbonates), silver bearing. From Deer Creek Silver Mining Co., 11 miles southeast of Porterville, Tulare County, Cal., by C. McK. Laizure, San Francisco.

19718. *Feldspar*–Orthoclase (potassium aluminum silicate). One mile from Springville, Tulare County, Cal., by W. P. Harman, Porterville.

19719. *Copper* ore (2 pieces). Sulphides (Chalcopyrite and Bornite); also Chrysocolla (silicate) and Malachite (carbonate). From Cuag Mine, Baltimore group, Merrimac district, Lone Mountain, 28 miles from Elko, Elko County, Nevada, by E. G. Weston, Oakland.

19720. *Limestone Marl* (calcium carbonate). Utilized for fertilizer purpurposes. From near Irvington, Alameda County, by Mission Lime Marl Co., Irvington.

19721. *Troilite*, iron mono-sulphide. The first recorded terrestrial occurrence of this mineral, previously known only in meteorites. From Del Norte County, by M. Vonsen, Petaluma. (Exchange.)

19722. *Magnesite* (magnesium carbonate). From 2 miles southeast of Chinese Camp, Tuolumne County, Cal., by Geo. M. Nelson, San Francisco.

19723. *Serpentine*, showing veinlets of *Chrysotile Asbestos*. From Moccasin Creek, 6 miles south of Jacksonville, Tuolumne County, Cal., by Geo. M. Nelson, San Francisco.

19724. *Thenardite* (sodium sulphate). A good grade of sodium sulphate. From San Bernardino County, Cal., by O. A. Cox, Needles, Cal.

19725. *Cinnabar* and *Metacinnabarite*, mercury sulphides. From Hastings Mine, Solano County, Cal., by Mr. Andrews.

19726. *Chalcedony* and *Quartz Geodes*. Silicon dioxide. From 5 miles northwest of San Luis Obispo, Cal., by Dr. B. F. Rogers, Kansas City, Mo. (Exchange.)

19727. *Silver Ore*. From Mt. St. Helena Mine, north of Calistoga, Napa County, Cal., by Walter W. Bradley, Berkeley.

19728 to 19732. *Sandstone* (Eocene-Tertiary), from state highway cut, near Chatsworth, Los Angeles County, Cal.; Biotite *Gneiss;* 'Silver-Gray' *Granite* from Lakeside (old 'Foster') Quarry; 'Santee Granite' (*Granodiorite*), Santee Quarry of Simpson-Pirnie Co. at Santee; 'Black Granite' (Hornblende *Diorite*). From quarry near Lakeside. The above four specimens from San Diego County, by Walter W. Bradley, Berkeley.

19733. Cemented *Conglomerate*. From Nuner Gravel Mine, Stockton Hill at Mokelumne Hill, by J. J. Riley.

19734. Black *Tourmaline* (boron-aluminum silicate, complex). From Temecula Minerals Co. mine near Winchester, Riverside County, Cal., by M. Machado, Temecula.

19735. *Pyrite*, iron di-sulphide. Used extensively for making sulphuric acid. From Tharsis Mine, Spain. Said to have 100,000,000 tons blocked out. By Geo. M. Nelson, San Francisco.

19736. *Gold-Silver* ore. From Goodshaw Mine, Bodie, Mono County, Cal. Outcrop of new strike August, 1922, by J. S. Cain, Bodie, Cal.

19737. *Gold* ore. High-grade, shipping ore, showing free gold. From Coso Mine, Beveridge district, Inyo Mountains, Cal., by Fred H. Spear, Olancha, Cal.

19738. *Asbolite*. Cobalt-bearing *Wad* (manganese oxide). From near Mokelumne Hill, Calaveras County, Cal., by Bert Hammel, Mokelumne Hill.

19739 and 19740. *Chalcopyrite*, copper-iron sulphide, with black coating of oxide, in sericite. High-temperature, replacement deposit in limestone; *Malachite*, basic copper carbonate. In sericite. From oxidized zone. From Atlas Mines, Silverbell, Arizona, by J. F. O'Reilly, Silverbell, Ariz.

19741. *Fluorite* (calcium fluoride). Crystals on Quartz. From Fluorspar deposit near Mt. Montgomery Station, Mineral County, Nev. Precious *Opal*, in opalized wood. From Virgin Valley, Elko County, Nev. Precious *Opal* (silicon dioxide). In matrix. From Virgin Valley, Elko Company, Nevada. By John Melhase, San Francisco.

19744. Nephelite (?) *Syenite*. From 6 miles northeast of Lindsay, Tulare County, Cal., by John Melhase, San Francisco.

19745 to 19747. *Salt* (sodium chloride), crude. First crystallization, after 2 months' evaporation of bay water, showing thickness of layer 4″ to 6″. Specimen cut during harvesting, Oct. 28, 1922; also specimen three years old; also specimen re-washed. From Moss Landing, Monterey County, Cal., by Monterey Bay Salt Co., Vierra Bros., Moss Landing, Cal.

19748. *Cuprodescloizite* (lead, zinc, copper vanadate, hydrous). From Goodsprings, Nevada, by John Melhase, San Francisco.

19749. *Hyalite* (silicon dioxide). Deposited in fracture in basalt. From Spokane, Washington, by Ernest Schernikow, San Francisco.

LABORATORY.

Frank Sanborn, Petrologist.

A total of 330 samples were received and determined during the thirty-day period covered by this report. This number is above the average for a winter month and is probably in part due to the new tariff on certain minerals.

A list of samples of possible commercial value, judged from the sample submitted only, is appended.

The Bureau will supply the name and address of the party who sent in any sample listed, upon request, if the reference number is given.

05–328	Gypsum.
05–329	Barite.
05–330	Arsenopyrite.
05–331	Opal.
05–332	Sepiolite (meerschaum).
05–333	Pyromorphite (a phosphate of lead).
05–334	Gypsum.
05–335	Arsenopyrite; also gypsum.
05–336	Diatomaceous earth.
05–337	Gypsum.
05–338	Hematite (red ochre).
05–339	Malachite, with a very little silver.
05–340	Arsenopyrite.
05–341	Garnet.
05–342	Cerargyrite (silver chloride).
05–343	Limonite (yellow ochre).
05–344	Galena, contains over 10 ozs. silver per ton.
05–345	Copper ore; contains some silver.
05–346	Pyrite concentrate; contains gold.
05–347	Barite.

LIBRARY.

E. COONEY, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received during the month, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey.

- Bulletin No. 709-L—Primary Traverse in Virginia, 1916-1918. By C. H. Birdseye, Chief Topographical Engineer.
- Bulletin 731—Bibliography of North American Geology for 1919–1920. By John M. Nickels.
- Bulletin 736-D—The Osage Oil Field, Weston County, Wyoming. By A. J. Collier.
- Bulletin 739-A—The Alaskan Mining Industry in 1921. By Alfred H. Brooks.
- Professional Paper 129—Shorter Contributions to General Geology, 1921. By David White, Chief Geologist.
- Professional Paper 130—The Laramie Flora of the Denver Basin. By F. H. Knowlton.
- Water Supply Paper 490-D—Routes to Desert Watering Places in the Papago Country, Arizona. By Kirk Bryan.
- Mineral Resources of the United States, 1919. Part II—Nonmetals.
- Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium and Vanadium in 1921. By Frank L. Hess.
- Sand and Gravel in 1921. By L. M. Beach.
- Gold, Silver, Copper, Lead and Zinc in Montana in 1921. By C. N. Gerry.
- Geological Survey of Alabama—Report on the Progress for the Fiscal Years 1918–1922.

U. S. Geological Survey—*Concluded.*

Geological Survey of Alabama, Museum Paper No. 6—The Anculosae of the Alabama River Drainage. By Calvin Goodrich.

Kentucky Geological Survey, Series 6, Vol. 5—Geology and Coals of Webster County.

Kentucky Geological Survey, Series 6, Vol. 8—Clay Deposits of Kentucky.

Wisconsin Geological and Natural History Survey, Bulletin 64—The Inland Lakes of Wisconsin. By Edward A. Berge and C. Juday.

Canada Department of Mines Branch—Talc and Soapstone in Canada. By Hugh S. Spencer.

Canada Department of Mines, Geological Survey. Summary Report, 1921. Parts B-E.

Canada Department of Mines, Geological Survey, Memoir 130, No. 111, Geological Series—Geology and Mineral Deposits of the Bridge River Map—Area, British Columbia. By W. S. McCann.

Bulletin of the Imperial Geological Survey of Japan. Vol. XXV, No. 4.

Bulletin on the Explanatory Text of the Geological Map of Japan—Yoshioka Special Sheet; Shobara Sheet.

Secretaria de Industria Comercio Y Trabajo—Boletin del Petroleo. Vol. XIII, Numos. 5–6.

Secretaria de Industria Comercio Y Trabajo—Boletin Minero, Organo del Departamento de Minas, Tomo XIII, Num. 5.

Societies and Educational Institutions.

Bulletin of the State University of New Mexico—Geology of the Sandia Mountains. By Robert W. Ellis.

Year Book of the American Ceramic Society, 1921–1922.

Mining and Metallurgical Society of America, October, 1922.

Proceedings of the American Philosophical Society, Vol. LXI. No. 3.

Proceedings of the Engineers' Society of Western Pennsylvania, June, 1922.

Monthly Bulletin of the Canadian Institute of Mining and Metallurgy, December 1922.

Alumni Number of the Colorado School of Mines, Vol. XII, No. 7.

Journal of Geology. October and November, 1922.

The Mining Congress Journal, November, 1922.

The Philippine Journal of Science, August, 1922.

Books.

Mineral Industry, Vol. XXX, 1921.

Maps.

U. S. Geological Survey Topographical Sheets:

Barnhart, Texas.
Confluence, Pennsylvania.
Dos Palos, California.
Friant, California.
Garrison, North Dakota.
Lafayette National Park, Maine.
Kerman, California.
Lake Crescent, Washington.
Munroe, Wisconsin-Illinois.
Moosehead Lake, Maine.
Pozo Farm, California.
Pozo Quadrangle, California.
Pysht, Washington.
Round Mountain, California.
Tyrone District, New Mexico.

Imperial Geological Survey Map of Japan.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Financial Insurance News, Los Angeles, California.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum Refiner, Kansas City, Missouri.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Bakersfield Morning Echo, Bakersfield, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport-Chronicle-Union, Bridgeport, Mono Co., Cal.
California Oil World, Los Angeles, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Georgetown Gazette, Georgetown, Cal.
Gilroy Gazette, Gilroy, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Lake County Bee, Lakeport, Cal.
Mariposa Gazette, Mariposa, Cal.
Mining and Financial Record, Denver, Colo.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.

Oatman Mining Press, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Etna Mills, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Sacramento Union, Sacramento, Cal.
San Diego News, San Diego, Cal.
Santa Barbara Daily News, Santa Barbara, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Siskiyou Standard, Fort Jones, Cal.
Stockton Record, Stockton, Cal.
Sunset Journal, Sunset District, San Francisco, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of consumers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

Sufficient publicity has not heretofore been given to this feature of the Bureau's work, but in 'Mining in California' a suitable medium is provided for current inquiries of this nature, and, therefore, written or verbal inquiries that come to the attention of the Bureau are summarized in each issue.

The name of the product wanted or offered, only, is published; the name of the owner of the deposit, or buyer, and other details being supplied upon request.

In writing, the reference number of the item should be given.

Mineral Products or Deposits for Sale.

02–146 High-grade silica sand; also hematite suitable for paint.
02–147 Hydraulic mine, equipped, Trinity County.
02–148 Large high-grade magnesite deposit less than one mile from railroad.
02–149 Coal deposit. Vein 6 to 16 feet thick; good quality, on highway in Trinity County.
02–150 Quicksilver deposit; also prospecting drill tools and casing.
02–151 Gold mine. Assays $12 up per ton. Price $2,000.
02–152 Copper ore.
02–153 High-grade manganese ore.
02–154 Gold quartz mine; has produced over one million; Sierra County. Four tunnels, no crosscutting.
02–155 Gem mine. (Tourmaline and Kunzite.) Three claims in San Diego County. Cash or terms.
02–156 Limestone deposit; eight miles from railroad; down-hill haul.
02–157 Dolomite. Twelve miles from railroad. San Benito County.
02–158 Silica, silica sand, and ground floated silica.
02–159 Limestone deposit; 3 miles from railroad; Kern County.
02–160 Arsenopyrite. Large body in Sierra County.

Mineral Products or Deposits Wanted.

03–129 Celestite (strontium sulphate).
03–130 Quicksilver deposit.
03–131 Colored rock granules (yellow, black, green, red, sparkling) for stucco dash; tonnage.
03–132 Bauxite deposit.
03–133 Montmorillonite or bentonite; tonnage.
03–134 Barite; deposit or tonnage.
03–135 Arsenical pyrite; large body.
03–136 Limestone deposit within fifty miles of Los Angeles.

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of applicants for positions and 'positions open,' received by the Bureau during each 30-day period preceding the date of publication of the Monthly Chapter is carried in each issue.

Each notice is designated by a key number, and communications sent to the Bureau in reply to any notice will be forwarded to the proper party without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss.

Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

01–45 Superintendent or assistant superintendent. Technical graduate; ten years' experience Utah, Nevada and California mines. Age 34; married; references. Salary wanted $250–$300.

01–46 Engineer. Technical graduate. Member A. I. M. E. Capt. Engineers, U. S. Army. Twenty years' experience in foreign countries and United States, covering designing, drafting, operation and construction of public works, railroads, mining and chemical plants. Speaks Spanish, Hindustani and Chinese fluently. Will accept moderate salary or share of profits. Detail record on file. References.

01–47 Assistant to mining engineer or drafting. Technical education. Two years' experience, mucking, mining, surveying and drafting. Age 23. Single. References. Salary open.

01–48 Mining Engineer, foreman or shift-boss. Eight years' general experience, mine surveyor, geologist and engineer. Age 33. Married. References. Salary open.

01–49 Geologic work in mining or oil. Graduate, specializing in geology. Age 22. Married. References. Salary open.

01–50 Laboratory assistant, assayer or chemist. Experience in analytical laboratory and assay office of large California mine. Age 24. References. Salary open.

01–51 Geologist. Technical graduate. Experience 1912–1922, covers copper, lead, zinc, gold, iron, manganese, chrome, asbestos, precious stones and coal explorations in Russia. Age 33. Married. References. Salary open.

INDEX FOR REPORT XVIII.

Page

- AA-1 Rock Salt and Chemicals Company 148
- Abby Mine 303
- Accident Mine (see Sybel).
- Ackers Mine 303
- Act changing period for doing mine assessment work 77
- Advance Mine 358
- Adventure quartz claim 738
- Afterthought Copper Company 595
  - Mine 595
  - Mine, flowsheet of 300-ton mill at 597
  - Mill and smelter at 596
- Agnall, John 104
- 'Agstone' (see agricultural limestone).
- Agricultural limestone and its possibilities in California 118–121
- Air separation processes, compared to wet concentration 324
- Akes Ranch well, gas in 536
- Akin, Samuel 44
- Alabama and Crystalline mines 99
- Alameda County:
  - Coal resources of, Bibliography 155
  - Limestone deposits in, Bibliography 751
  - Mineral production, 1921 561
  - Mining activities in 143
  - Oil development in 50
  - Table showing total mineral production, 1890–1921 634
- Alaska Mine 21, 271
- Albino Mine 305
- Alcalde Mine 139
- Alcalde Gold Mines Company 738
- Allanite, occurrence of 345
- Alleghany District, Sierra County, quartz mining in 499
  - Map of 500
  - Wage scale in 737
- Alleghany Mining Company (see Tightner Mine).
- Allured Copper Mine 611
- Alpine County:
  - Activities in 355
    - Bibliography of geology and mines of 363
    - Bibliography of limestone deposits in 751
    - Geology and mineralogy 356
    - Mines of 358
      - Copper mines of 361
    - Ore treatment 357
    - Summary and conclusion 362
    - Transportation 355
    - Water power and timber 356
  - Mineral production, 1921 561
    - Table showing total mineral production, 1880–1921 635
- Alpine Mine 359
  - Fairview Mine 361
  - Quicksilver Mining Company 215
- Alta California Gravel Mine 139
- Alta Combination Mine 140, 738
- Aluminum, 1921 statistics 239
- Amador County:
  - Activities in 7, 298
  - Analysis of coal from 185
  - Coal resources of, Bibliography 155
  - Limestone deposits in, Bibliography 751
  - Mineral production, 1921 562
    - Table showing total mineral production, 1880–1921 636
- Amblygonite (see Lithia).

American Asbestos Company (see Pacific Asbestos Corporation).
        & Manufacturing Company (see Pacific Asbestos Corporation).
    Bar Quartz Mine 261
    Bar Mine 738
    Canadian Oil Products Company 424
    Encaustic Tiling Company 557
    Gold Dredging Company 6, 43
    -Italian Hydraulic Company 97, 257
    -Italian Mining Company 207
    Magnesium Company 742
    Manganese Products Company 46, 385
    Mining Congress, statement on mining assessment 236
        Exposition, California exhibit at 54
        Mining assessment, statement on 236
    River, gold gravels of 223
    Trona Company 222
Anaconda Gold Mining Company 265
Analyses of:
    California coals, Bibliography of 155
        Amador County 185
        San Benito Coal Mining Company 146
    Gas from The Geysers, Sonoma County 549
    Gypsum in Avawatz Mountains 115
    Lost clay 555
    Oil sands 275
    Water from Valley View Prod. Company's property 603
    White metal rock 87
Anapaite, occurrence of, in Tulare County 720
Anavina Mine (see Peerless Group of Mines).
Angels Camp Deep Mining Company 97
Antelope Valley District 414
Antimony, 1921 statistics 240
    In San Benito County 214
    In Tulare County 523
Apapha Magnesite Mine 531
Aquamarines in California 332
Arbuckle Mine (see Bell Cow Mine).
Arbuckle, T. B. 97
Arcadia claim (see New York and Arcadia claims).
Argonaut Mine 209, 298
Argus Sterling Mine 740
Arlyngton Mining Corporation 742
Arsenic, statistics, 1921 240
Arsenopyrite, in Alleghany District ores 501
Asbestos, 1921 statistics 179–182
    Classification and characteristics 180
    Grading of 181
    Value and production 182
Asbestos in Napa County 419
    San Benito County 214
    Tulare County 523
Asbestos Producing Company of California (see Pacific Asbestos Corporation).
Asphalt and bituminous sand deposits in California, memoranda on 228
Asphalt, in San Benito County 214
Asphalt, 1921 statistics 327
Assessment year, change in mine 77, 234
Associated Oil Company operations in Berryessa Valley 609
Auburn Field Division 6, 44, 97, 139, 208, 258, 298, 355, 413, 499, 602, 736
    Condition of metal mining in 1922 736–740
Austin, H. C. 43
Avawatz Mountains, economic minerals of 114–117
Avawatz Salt & Gypsum Company 232

Bablew Mining Company 97
B. A. C. Mine 606
Bader Bros. Mine 258
Bailey, F. B., Ranch, tin ore in 9
Bain, H. Foster 25
Baker Gold Mining Company 303
Balaklala Copper Company 296
Balaklala Mine 138
Bald Mountain Mine 524

Page

Balfron Mine 303
Ballou Group of Mines (see Manzanita Mine).
Ball Quartz Mine 496
Baltic Mining Company 105
Baltimore Drift Mine 739
Bancroft, Geo., cited 314
Banner Consolidated Mines Company 7
Bannister, Wm., and John Dowling 600
Barber, Edwin Atlee, cited 555
Bard Hill Gravel Mine 99
Bardin Bros. Ranch, barite on 214
Barite, in San Benito County 214
  In Shasta County 43
  In Avawatz Mountains 115
Barstow Mining & Milling Company 148
Barton Mine 527
Barytes, 1921 statistics 183
Basin Slope claims 101
Bates Mine, A. C. 606
Bauxite, from Riverside County 198
  Test for 198
Bear Barytes Company 146
Bear River, gold gravels of 226
Beardsley Copper Company 605
Beck, Fanny H., and Louise K. Knapp 9
Beik prospect 607
Bella Union Mine 395
Bell Cow Mine 296, 493
Belmont Group 502
Belmont Shawmut Mine 99
  Tuolumne County, ore treatment at 748
    Flowsheet of mill at 750
Ben Hur Mine 309, 539
Benitoite, in San Benito County 217
  In California 332
Benton District 418
Bentonite refining plant 9
Benton mill 365
Bent Ranch well, gas in 536
Bernal Marl Fertilizer Company 102
Berryessa Valley, oil possibilities in 608
Beryls in California 332
Bibliography:
  Coal in California 152
  Iron ore occurrences 113
  Geology and mines of Alpine County 363
  Limestone deposits in California 751
Big Canyon Mine 209
Big Dyke Mine 317
Big Four mines 295, 353
Big Gem Group (see Florida and Big Gem).
Bigelow Mine 737
Billy Williams Mine 21
Bishop Community Gold Producers Mining Company 418
Bishop Creek Milling Company 419
Bismuth, statistics, 1921 240
Bituminous rock 183–184
  In San Benito County 215
  Statistics, 1921 184
  Sand deposits of California (see asphalt).
Black Bear Mine 737
Black Diamond Group 296
Black Hawk Mine 539
Black Wonder Mine 18, 21
Blaney Ranch well, gas in 536
Blazing Star Mine 18, 21
Blue Crystal Magnesite Mine 531
Blue Eyes prospect 211
Blue Eyes property (see Gold Dollar Mining Company).
Blue Gravel Mine 731
Blue Hog Mine 258

Page
Bluejay, in Alleghany District ores ---- 501
Boalich, E. S. ---- 110, 152, 211, 363, 413
Bobbie Mining Company ---- 364
Bodie District ---- 417
Bojo Mining Company ---- 104
Bolliver Mine ---- 355
Bonanza Group ---- 207, 271
Bonanza King Mine ---- 355
Bonanza Mine ---- 44, 99
Books acquired for library ---- 90, 134, 202, 251, 290, 399, 488, 590, 763
Borax, 1921 statistics ---- 281
Borax from Owens Lake ---- 420
Boulder Hill Mine ---- 360
Bowery Mine (see Alcalde).
Bowles, O., cited ---- 464
Bradley Walter W.
---- 31, 54, 83, 128, 179, 220, 239, 275, 281, 327, 382, 429, 545, 560, 633, 757
Brandy City Hydraulic Mine ---- 737
Brick and tile, statistics, 1921 ---- 454
Bridgeport District ---- 417
Briquetting of California coals, Bibliography of ---- 155
Brooklyn gold claim ---- 221
Brown, A. G., and W. L. Tickner ---- 97
Brown Bear Mine ---- 256
Brownie Group ---- 416
Brunswick Mine ---- 738
Brush Creek Mine ---- 502
Brush Placer Mine (see Blue Gravel Mine).
Buckskin Mine ---- 595
Buena Vista Mine ---- 21
Bullion Hill Mining Company ---- 98
Bully Hill mines (see also Shasta Zinc and Copper Company) ---- 43, 410
Bunker Hill Mine ---- 298
Burch, Albert ---- 25, 377
Burgess and Cummings lease ---- 416
Burt Bros. Ranch well, gas in ---- 537
Butte County, activities in ---- 258
  Bibliography of coal resources of ---- 155
  Bibligraphy of limestone deposits in ---- 751
  Iron ore in ---- 110
  Mineral production, 1921 ---- 562
  Table showing mineral production 1880–1921 ---- 638
Butterfly Drift Mine ---- 258
Butterfly Mine ---- 303
Buzzard Mine ---- 209
B. V. D. Mining Company ---- 364

Cadmium, statistics 1921 ---- 241
Calaveras Copper Company ---- 98
Calaveras County, activities in ---- 7, 15, 97
  Bibliography of coal resources of ---- 155
  Bibligraphy of limestone deposits in ---- 751
  Iron ore in ---- 110
  Mineral production, 1921 ---- 563
  Table showing total mineral production, 1880–1921 ---- 640
Calaveras River, gold gravels of ---- 226
Calcining plant, Sierra Magnesite Company, flow-sheet of ---- 533
Calcium chloride, statistics, 1921 ---- 482
Caledonia Mine ---- 303
California Alkali Company ---- 420
  Asbestos Company (see Pacific Asbestos Corporation).
  Asbestos Mining Company ---- 46, 214
  Chemical Company ---- 383
  Chrome Company ---- 25
  Copper Corporation (see Engels Copper Mining Company).
  Exploration Company ---- 98
  Granite Company ---- 527
  Graphite Leasing Company ---- 221
  Gypsum Corporation ---- 421
  Hot Springs ---- 535
  Jade (see Californite).

Page
California Metal and Mineral Producers Association 377
  Mine 45
  Mineral production in 1921, estimate of 31
  Minerals exhibited during Shrine Convention 275
  Natural Gas and Development Company 537
  Oil Mining Corporation 273
  Pottery Company 8, 102
  Rand Silver, Inc. 104, 222, 265, 310, 368, 422, 540, 611, 742
  Rock Products Company 221
  Rock Salt Company 613
  State aid to mining in 624
    Needs of the mineral industry 627
  Sulphur Company 481
  Talc Company 539
California's Exhibit at the American Mining Congress Exhibition, Chicago 54
  Mineral Resources and the State Mining Bureau 618
    Fuels 619
    Metals 619
    Mineral production, value of 622
    Industrial materials 621
    Salines 621
    Structural materials 620
    Summary of future outlook 622
Californite in California 332
Calnan Group 6
Canada Hill mines 602
Canary Mine 303
Canfield Ranch Well, gas in 537
Capell Valley Corporation, Operations in Napa County 610
Capitalization of oil industry 446
Carlton Mine 18, 21
Carmack, George 263
Carmack Placer Mines 603
Carpenter, S. and E. M. Robertson 97
Carire Todd claim (see Texas Hill Mining Company).
Carson Hill Gold Mines, Inc. 98
Casa Diablo district 418
Casa Diablo Mine 418
Celestite (see Strontium).
  in Avawatz Mountains 116
Cement, 1921 Statistics 282
  in San Benito County 215
Centennial Mine 263, 301
Central Eureka Mining Company 299
Central Mine 494
Cerium metals, occurrence of 345
Cerro Gordo Mines Company 420
Champion Mine 18, 21
Change in mine assessment year 88
Change in personnel 30, 633
Channels, buried (see Placer Gold Investigation).
Chariot Mine 106
Chart showing organization of State Mining Bureau 630
Chemical Refining Company 420
Chemung Mine 415
Cherokee Mine 258
  Tulare County 527
Cheyenne Mine 143
Chicago and Silver Falls Group 354, 413
China Clay in California 554
  Historical 554
  Present operations and products manufactured 556
China Products Company 557
Chrome, in Tulare County 523
Chromite, Pacific Coast representatives 25
Chromite, Statistics, 1921 284
  in San Benito County 215
Chrysoprase in California 332
City of Six Mine 737
Claimants, war materials relief, statement to 24

Page
Clark & Becket Creamery well, gas in . . . 537
Clay, China, in California . . . 554
Clay (pottery) statistics, 1921 . . . 473
Clay in San Benito County . . . 215
  in Tulare County . . . 523
Climax Mine . . . 320, 729
Clio Mine . . . 100
Cloverdale Mine . . . 395
Coal . . . 184–185
  In California, Bibliography of . . . 152
  Analyses of California coals . . . 155
    Briquetting . . . 155
    Manufacture of producer gas . . . 155
    Resources of Counties . . . 155
    Amador County, from . . . 185
    San Benito Coal Mining Company, from . . . 146
    General Articles . . . 154
  in Contra Costa County, early production . . . 644
    Lassen County . . . 295
    San Benito County . . . 9, 216
    Tulare County . . . 9
  On stock-raising lands . . . 22
  Statistics, 1921 . . . 185
  Yield of oil from . . . 184
Coalinga Mining Association . . . 104
Coast region, Gaviota Pass to Santa Barbara, asphalt in . . . 229
Cobalt, statistics, 1921 . . . 242
Coffee Creek Mining Company . . . 207
Collom, R. E. . . . 10, 49, 106, 150, 223, 266, 311, 370,425, 437, 438, 543, 615, 745
Colorado District, Mariposa County . . . 365
Colorado Mine . . . 303
  No.2 Mine . . . 360
Columbus Mine . . . 7, 19. 21
Colusa County:
  Bibliography of coal resources of . . . 155
  Bibliography of limestone deposits in . . . 751
  Mineral production 1921 . . . 563
  Mineral production 1875–1921, Table showing total . . . 643
  Oil development in . . . 266
Comanche Mine . . . 418
Commissioner of Corporations, file of permits of . . . 30, 82
Committee on mineral imports and exports . . . 26
Compost, mineral . . . 529
Comstock Rand claims . . . 104
Conrad Mine . . . 302
Consolidated Four Mine (see Waterloo).
Consolidated Manganese Company . . . 385
Constitution Mine . . . 143
Consumers and producers . . . 37–38, 91, 135, 203, 253, 292, 351, 402, 490, 592, 726, 766
Contact mines . . . 502
  Mining Company (see Wonder Min).
Continental Mine . . . 320
Contra Costa County:
  Activities in . . . 45, 144, 263
  Bibliography of coal resources of . . . 155
  Bibliography of limestone deposits in . . . 751
  Mineral production 1921 . . . 563
  Mineral production 1894–1921, Table showing total . . . 644
Conzetti Mine . . . 97, 206
Cooney, E. . . . 35, 89, 132, 200, 249, 288, 347, 398, 486, 588, 722, 762
Copper:
  In San Benito County . . . 216
    Tulare County . . . 523
  Of Alpine County . . . 361
  Statistics 1921 . . . 450
  Copper Basin Consolidated Mines Company . . . 308
  Copper Bottom Mine . . . 211
Corn Meal Mine . . . 21
Costs, at Engels Copper Mine . . . 605
  mining, at North Star Mines Company . . . 141
Cosumnes River, gold gravels of . . . 226

Page
Council of National Defense 26
Counties, Mineral production in 1921, by 560–587
    Table, comparative value of mineral production of 1920 and 1921 431
Cove Mining District 146
Coyote Mine (see Randsburg Silver Mining Company).
Creeks Mine 527
Crescent Mine (see Green Mountain and Crescent mines).
Croesus Gold Mining and Milling Company (see Plumbago Mine).
Crowell Ranch well, gas in 536
Crushed rock (see miscellaneous stone).
Crystal Lake property 418
Crystalline and Alabama mines 99
Crystal Mine (see White Star Silver group of mines).
Crystal Springs Mine 303
Cub Bear Mine 97, 139, 495
Curtz, Peter 358, 359, 360

Dairy Farm Mine 45
Daisy Mine 303
Dallas Mine 332
Dallas, R. W., gem deposit 217
Dan Greeg Lands well, gas in 537
Dannenbrink property (see Pittsburg-Comstock Company).
Darwin Silver Company 420
Davidson Bros., pocket on Vesa Creek 354
Davis, Norris K. 214
Dead River Group 502
Deep Pit group of mines 598
Deer Creek Silver Mine 537
Deerfort Mine 21
Del Norte County:
    Bibliography of coal resources of 155
    Mineral production, 1921 564
    Mineral production, 1880–1921, Table showing total 646
    Mining activities in 295
    Triolite in 131
De Luxe prospect (see Granger prospect).
Department of Public Works 8
Depth of mines in El Dorado County 209
Descanso Mining Syndicate 149
Determinations, list of laboratory 34, 86, 131, 198, 248, 287, 345, 397, 485, 587, 761
Diamonds in California 331
Diana Development Company 418
Diana Mine 303
Diatomaceous earth (see infusorial and diatomaceous earths).
    in Los Angeles County 366
    in San Benito County 217
Diatoms characteristic of marine and fresh water, genera of 59
Dickey Granite property 527
Diller, J. S., cited 315
Dinneen Marble Company 417
Distillation plant, asphalt 229
Distribution of publications 29, 81, 126, 177, 237, 279, 325, 380, 427, 558, 755
District reports of mining engineers 5, 42, 96, 138, 206, 256, 295, 353, 405, 493, 595, 729
Dittmar, E. M., cited 313
Dividends paid by oil companies 447
Division of Minerals and Statistics 31, 34, 83–88, 128–131, 176, 179–196, 239–248, 281–287, 327–344, 382–397, 429–485, 560–587, 631, 633–719, 757–760
Docile Mine 503
Dolly Varden Mine 538
Dolomite in San Benito County 217
Dolomite, Statistics, 1921 327
Domestic well, Alpaugh, gas in 535
Double Header Mine 138, 354, 405
Dowling, John, and William Bannister 600
Drafting Department 30, 82, 127, 178, 238, 280, 326, 381, 428, 559, 633, 756
Dreadnaught Mine 503
Dredge in San Luis Obispo County 424
Dr. McDougall Mine (see Descanso Mining Syndicate).
Dry Placers of Southern California 321

Page
Dull Mine 140
Duparc, Louis, cited 158
Duty on graphite, proposed 221
Duty on potash, proposed 222

Eagle Bird Mine 738
Eagle Gold Mining and Milling Company 301
Eagle Mine 306
Eakle, Dr. A. S., cited 88
East Fork Mining District, Trinity County, gold lodes of 270
Eclipse No. 2 Mine (see Bald Mountain Mine).
Economic minerals of Avawatz Mountains 114–117
Edwards Group 503
El Dorado County:
  Activities in 44, 208, 301, 602
  Bibliography of limestone deposits in 751
  Depth of mines in 209
  Iron ore in 110
  Mineral production, 1921 564
  Mineral production, 1880–1921, Table showing total 648
  Slate quarries in 602
El Dorado Mine 405, 503
El Dorado Wisconsin Gold Mining & Milling Company (see El Dorado Mine).
Elgin Mine, sulphur at 481
Eliza Mine 297, 600
Elkonite 330
Emigrant Hill Mine 736
Empire China Company 556
Empire Mine 140, 737
Empire Mine, Madera County 303
Empire Mine, Tulare County 538
Employment Service 39, 92, 136, 204, 254, 294, 352, 403, 491, 593, 727, 767
Engels Copper Mining Company 605, 736
Engineering & Mining Journal 25, 618
Enterprise Mine 207, 271
  Madera County 303
  Gold Mining Company (see Lucky John Mine).
Estabrook Gold Dredging Company 258, 734
Estabrook dredge 297, 601
Estelle Mining Company 421
Eureka Mine 21, 354
Evening Star Mining Company (see Steifer Mine).
Excelsior Mine 21
Exchequer Mine 360
Exhibit, California, at American Mining Congress Exposition 54

Fairview prospect 209
Farnsworth, Archie 97
Farnsworth Bros. Mine 6
Faudre and Walsh group 416
Feather Forks and Maxine mines 736
Feather Forks Gold Gravel Company 604
Feather River, gold gravels of 226
Feather River Land and Mining Company (see Blue Hog Mine).
Feather-Stone Insulation Company 366
  Geology of deposit 366
  Plant of 367
  General 367
Feldspar, 1921 statistics 328
  in Tulare County 523
  Ferguson, H. G., cited 499
Ferguson Mine 21
Fields, J. D. 10
Fields, natural gas 436
Files and mails 30, 82, 127, 178, 238, 280, 326, 381, 428, 559, 633, 756
Financial and operating conditions, 1921, oil fields 443
Finney Mine 737
Fischl, Hugo 212
Five Oaks Mine 303
Five Pines Mine 355
Flag Mine 297
Flint Estate, gold on 217

Page

- Florence G. Mine 527
- Florence group 214
- Florida and Big Gem group 494
- Flotation, at Afterthought Mine 597
- Flotation machines, use of on oil sands 10
- Flow-sheet, Afterthought Copper Company, 300-ton mill of 597
  - Belmont Shawmut mill, Tuolumne County 750
  - Sierra Magnesite Company's calcining plant 533
- Fluorspar 185–186
  - 1921 statistics 186
- Flying Dutchman Mine 303
- Foster Gold Mining Company 355
- Foster Group 221
- Fox and Barret leases 221
- Fox, E. L., Ranch well, gas in 537
- Franklin Group 43
  - and Milkmaid mines 406
- Freda Mine 303
- Fremont Mine 299
- French Group 214
- Fresno County:
  - Bibliography of, coal resources of 155
  - Limestone deposits in 752
  - Mineral production, 1921 565
    - Table showing total, 1880–1921 650
  - Mining activities in 101
  - Oil development in 50, 150, 224, 266, 425, 615, 745
- Fuels, statistics, 1921 433–449
  - Natural gas 433
  - Petroleum 436
- Fuller's earth, statistics, 1921 329
- Fulton Ranch well, gas in (see Williams Ranch).

- Gaither, J. C. and Chas. Reed 295
- Gambetta Mine 303
- Ganim Mine 730
- Garbe and de Maria Mine 739
- Gardella dredge 43
- Gardella, L., new dredge of 297, 496, 601, 734
  - Lease of 601, 733
- Gas (see Natural gas).
  - Analysis of, from The Geysers, Sonoma County 549
  - Radioactivity in, at The Geysers 545
- Gasoline from natural gas 435
- Gems, in San Benito County 217
  - in Tulare County 523
  - 1921 statistics 331
  - Varieties of California 331
- Genera of diatoms characteristic of marine and fresh water 59
- Geology and mines of Alpine County, Bibliography of 363
- Geology of Feather-Stone Insulation Company's deposit 366
  - of West Point district 15
- George property (see Thoroughbred Mining Company).
- Georgia Hill Mining Company 211
- 'Geyser' wells in Napa County 387
- Geysers (see The Geysers).
- Gibson, W. W. 19
- Gifford Mine 497
- Gilbertson Mine 21
- Gilta Mine 257
- Gladstone Mine 43, 96, 256
- Glen Drift Mine 603, 739
- Glenn County:
  - Limestone deposits in, Bibliography of 752
  - Mineral production, 1921 565
  - Mineral production, 1893–1921, Table showing total 652
  - Mining activities in 263
- Glenn Drift Mine 7
- Gold:
  - in San Benito County 217
  - in Tulare County 524

Page
Gold Ball Group. 97
  Bug property 301
    Mine (see Kelliher Mining Company).
  Canyon Mine 505
  Dollar Mining Company 211, 256, 603
  Dredge, Yuba, exhibited at Shrine convention 278
  Galena Mine 21
  Hill Mine 44
  King prospect 505
    Mine 505
  Lead Placer Mine 738
  Leaf Mine 296, 298, 354, 406, 495
  Lodes of the East Fork Mining District, Trinity County 270
  Mono Lake 418
  Mountain Mine 424
  Placer resources 11
  Progress report on placer investigation 123
  Properties in Randsburg district 105
  Specimens exhibited at Shrine convention 277
  Outlook for 1922 333
  Production in 1921 333
  Star Mine 44
  Statistics 1921 333
  Total production of California 336
Golden Arrow Mining Company 607
  Chest Mine 272
  Gate Mine 414
  Jubilee Mine 207
  King United Mine 541
  Road Mine 304
  State Property Well, gas in 536
Goodall and Perkins Drift Mine (see Butterfly Drift Mine).
Good Hope Mine 222
  et al. mine 21
Goodshaw Mine 417
Gowing, F. A. 97
Grading asbestos 181
Grady shaft No. 1, Randsburg 541
Grand Eagle Mining Company 104
Granger prospect 505
Granite, in Madera County 305
    in Tulare County 527
  Silver-gray, exhibited at Shrine convention 278
  Statistics, 1921 458
  Varieties of 460, 527
Granite Mine 600
  Rock Company 220
Grant, Wm. M. 59
Graph showing annual value and increase of mineral production from 1890 to 1920 623
Graphite 186–187
  Statistics 1921 187
  in Tulare County 527
Grass Valley Boundary mines 737
Gravel (see miscellaneous stone).
Gravels, placer (see Placer Gold Investigation).
Gray Mine 21
Green Campbell Estate, mines of 9
Green Mountain and Crescent mines 736
Gridley, Haines 7
Griffin Company, The 362
Griffith Oil Company's operations in Berryessa Valley 609
Grinding mill pebbles (see miscellaneous stone).
Gruss Mining Company (see Surcease Mine).
Gypsum:
  Chemical and physical properties 234
  Types of deposits 231
  Uses and history 233
  in Avawatz Mountains 115
    Imperial County 421
    San Benito County 218
    Southern California 230
    Tulare County 527
  Statistics 1921 338

Page
Hagerman Mine 7
Hall Ranch Well, gas in 537
Haley, Chas. S. 11, 78, 123, 226, 321, 373, 550
Hamilton, Fletcher 4, 24, 88, 375, 618
Hanks, Henry G., cited 439
Hanna, G. Dallas 59
Hanover Mine 304
Hansonville Mine (see Yuba Gold Mining Company).
Harmon feldspar deposit 524
Harriman Mine 100
Havilah Mine 45, 740
Hawkeye Mine 304
Hayes, E. T. 257
Hayfork Creek, platinum mining on 298
Hayfork Mine 600
Henley feldspar deposit 524
Hercules Mining Company 209
Hercules Powder Company 26
Hershey, O. H., cited 314
Hickey Homestead Hydraulic Mine 496
Hidden Cave Mine 21
Hidden Treasure Mine 101
Hidden Vault Hillside Mining Company 104
High Grade Mine 304
Highland Chief Mine 259
Highland Mine 97, 496
High Light Mining and Milling Company 297
Hilda Mine 737
Hill, J. M., cited 198
Hines, Mrs. Alice D. 101
  Gilbert property 209
Hoboken Mine (see also Flying Dutchman) 496
Hoff Magnesite Company 143
Holland Dairy Ranch Well, gas in 536
Homer Knowles Pottery Company 556
Homestake Mine 527
Homestake Quartz Mine 495
Home Ticket Mine 739
  Property 211
Honeycomb Mine (see Simpson Mining Company).
Hook and Ladder Mine 45
Hornet Mine 6, 42
Hornets Nest Mine 304
Horseshoe Mine 607
Hot Springs, radioactivity in gases at 545
Hotze, P. J., Lease 416
Hubbard Mine 49
Humboldt County:
  Bibliography of coal resources of 155
  Limestone deposits in 752
  Mineral production, 1921 566
  Mineral production, 1880–1921, Table showing total 654
  Oil field, development in 425
Humboldt Trading Company (see Napetro Producing Company).
Humbug Mining Company 207
Hunter Ranch Well, gas in 537

Ichthyol in oil in Napa County 107
Idaho Maryland Mines Company 140, 737
Ida May Quartz Mine 297
Imperial County:
  Bibliography of limestone deposits in 752
  Gypsum in 232
  Mineral production, 1921 566
  Mineral production, 1907–1921, Table showing total 653
  Mining activities in 47, 104, 421
  Oil development in 150
  Radioactive mineral from 247
Imperial Gypsum Company 48, 232
Independence Mining Company 263
Independent Producers Agency 439
Industrial Accident Commission 429

Page

- Industrial materials:
  - Statistics, 1921 472–481
  - Clay (pottery) 473
  - Silica (sand and quartz) 477
  - Soapstone and Talc 478
  - Strontium 480
  - Sulphur 480
- Infusorial and diatomaceous earths, 1921 statistics 339
- Introduction 3
- Inyo County:
  - Activities in 419, 539, 611, 740
  - Bibliography of limestone deposits in 752
  - Mineral production, 1921 566
  - Mineral production, Table showing total, 1880–1921 656
- Inyo Development Company 421
  - Talc Company 421
- Irelan Mine 506
- Iridium (see metallurgy of platinum).
  - in Trinity County 711
- Iron ore 187–190
  - Industry on Pacific Coast 188–190
  - in San Benito County 218
    - Shasta County 112, 732
    - Tulare County 527
  - Occurrences in California, notes on 110–113
  - Statistics, 1921 190
- Italian–American Mining Company (see Mud Springs Mine).
- I. X. L. Mine 361

- Jacobs Estate feldspar deposit 524
- Jacobs Hydraulic Mine 257
- Jamison Mine 604
- Janice group of mines 598
- Janoko, George, coal prospect 9
- January Mine 395
- Jefferson Consolidated Mine 206, 297
- Johnson, E. 295
- John W. Coats Mine 304
- Jones & Company, C. D. 96, 409
- Jones Mine 45, 739
- Jo Rand Smelting Company 48
- Josephine Mine 304
  - Tulare County 527
- Jumbo Salt Area, Avawatz Mountains 117
- June Bride Mine 496
- Juniper Mine 595

- Kanaka prospect 507
- Kate Hardy Mine 507
- Kaweah Lime Products Company 529
  - Molybdenum Mines Company 47
- Kelleher Mining Company 739
- Kelly Mine (see California Rand Silver, Inc.).
- Kelly Rand Extension 104
- Kelsey Mine 422
- Keltz Mine 19, 21
- Kennedy Mine 299
- Kenosha Mine (see Alcalde).
- Kenton Mine 508
- Kentuck property (see Mono Mines Company).
- Kern County:
  - Bibliography of coal resources of 155
  - Limestone deposits in 752
  - Mineral production, 1921 567
  - Mineral production, 1880-1921, Table showing total 659
  - Mining activities in 9, 48, 104, 146, 220, 307, 539
  - Oil development in 50, 106, 108, 150, 224, 266, 311, 370, 425, 543, 615, 745
- Kern Rand Silver Mining Company 104
- Kerst and Regnier prospect 542
- Keynote Mine 139, 354
- Keystone Mine 737
  - Gold Mining Company 737
- Kilaga water (see Valley View Products Company).
- Kingbird Mine 607

Page

- King Mine 614
- Kingsbury, W. S. 122
- Kings County:
  - Mineral production, 1921 568
  - Mineral production, 1894–1921, table showing total 658
  - Oil development in 51, 150, 745
  - Phosphate rock from oil well in 287
- King Solomon Mine 266
  - Mines Company 105
- Kingsley district, Mariposa County 365
- Kirkland, A. P., copper prospect 523
- Kirkpatrick Mine 737
- Knapp, Louise K. and Fanny H. Beck 9
- Kroromick Mining Company 304
- Kunzite in California 332

- Laboratory 31–33, 85, 130–131, 198, 247, 287, 345, 397, 485, 587, 720, 761
- Laboratory determinations, list of 34, 86, 131, 198, 248, 287, 345, 397, 485, 587, 721, 761
- Ladoo, R. B., cited 479
- Lady Alice Mine 523
- Lady Ellen Mine 304
- La Grange Hydraulic Mine 257
- Laizure, C. McK. 5, 8, 30, 45, 101, 118, 143, 234, 263, 303, 519, 608, 740, 751
- Lake County:
  - Activities in 9
  - Bibliography of coal resources of 155
  - Limestone deposits in 752
  - Mineral production, 1921 568
  - Mineral production, 1873–1921, table shoing total 660
- L. and L. Mining Company 266
- Lands, tide and submerged, leases to extract minerals in 122
- Lane, Franklin K. 26
- La Panza placers 424
- Lassen County:
  - Bibliography of coal resources of 156
  - Bibliography of limestone deposits in 752
  - Coal, discovery in 295
  - Mineral production, 1921 568
  - Mineral production, 1880–1921, table showing total 661
  - Mining activities in 595
- Last Chance Mine 527
  - Mines 296
- Layman Mine 207, 600
- Lead, statistics, 1921 451
- Lead-zinc, in Tulare County (See zinc-lead).
- Leases of State mineral land 122
- Lemon Cove Lime Quarry 529
- Leonard Estate, diatomaceous earth on 217
- Lepidolite (see Lithia).
- Leroy Mine 421
- Lewis Creek, copper on 216
- Lewiston Gold Dredging Company 139, 297, 601, 733
- Liberty Hill Hydraulic Mine 738
- Library 35–36, 89–90, 132–134, 176, 200–202, 249–252, 288–291, 347–350, 398–401, 486–489, 588–591, 632, 722
- Library, list of official publications received in 35, 89, 132, 200, 288, 347, 398, 486, 588, 722, 762
- Lignite (see coal).
- Lime, statistics, 1921 340
  - Phosphate, in Tulare County 587
- Limestone 9
  - Agricultural, and its possibilities in California 118–121
  - Bibliography of deposits in California 751
  - in Avawatz Mountains 115
  - in San Benito County 218
  - in Shasta County 733
  - in Tulare County 529
  - Statistics, 1921 340
- Lind, Dr. S. C., cited 87–88

Page

List of:
    Laboratory determinations ---- 34, 86, 131, 198, 248, 287, 345, 397, 485, 587, 721, 761
    Mineral products or deposits for sale ---- 37, 91, 135, 203, 253, 292, 351, 402, 490, 592, 726, 766
    Mineral products or deposits wanted ---- 38, 91, 135, 203, 253, 293, 351, 402, 490, 592, 726, 766
    Museum specimens received and catalogued ---- 84, 129, 197, 246, 287, 344, 757
    Official publications received in library ---- 35, 89, 132, 200, 249, 288, 347, 398, 486, 588, 722, 762
    Publications distributed ---- 29, 81, 126, 177, 237, 279, 325, 380, 427, 558, 632, 755
    Positions wanted ---- 39, 92, 136, 204, 254, 294, 352, 491, 593, 727, 767
Lithia, statistics, 1921 ---- 382
Little Nellie Mine ---- 139
Little Wonder Mining Company ---- 365
Location, mining, on stock-raising lands ---- 22
Lockwood Mine ---- 19, 21
Logan, C. A. ---- 6, 15, 44, 78, 97, 124, 139, 208, 258, 298, 355, 413, 499, 602, 736, 748
Logan Mine ---- 306
Lone Pine Mine ---- 96
Lone Point Mine ---- 21
Lone Star Mine ---- 20, 21
Long-Ryan Mine ---- 46
Lookout Mine ---- 45
Lorenz Hydraulic Mine ---- 6, 97, 207, 257
Lorenz, John ---- 6
Los Angeles County:
    Asphalt in ---- 230
    Bibliography of coal resources ---- 156
    Bibliography of limestone deposits in ---- 752
    Iron ore in ---- 110
    Mineral production, 1921 ---- 569
    Mineral production 1880–1921, table showing total ---- 665
    Mining activities in ---- 9, 221, 264, 366, 422, 741
    Oil development in ---- 51, 106, 108, 150, 224, 267, 311, 371, 425, 543, 615, 745
Los Angeles Field Division ---- 9, 47, 104, 146, 220, 264, 307, 366, 419, 539, 611, 740
Losh Slate Quarry ---- 602
Los Padres Placer, Inc. ---- 741
Lost Channel Gravel Mine ---- 495, 599
Lost Clay, analysis of ---- 555
Lost Clay deposit, discovery of ---- 555
Lost Treasure Mine ---- 422
Louderback, Geo. D. ---- 25
Lucky Bill Mine ---- 304
Lucky Jim Mine ---- 420
Lucky John Mine ---- 259
Lundy and Mono Lake district ---- 417
Luning Mineral Products Company ---- 144
Lyons Gypsum Company ---- 218

Madera County:
    Bibligraphy of limestone deposits in ---- 752
    Gold mines in ---- 303, 306
    Granite in ---- 305
    Iron ore in ---- 111
    Mineral production, 1921 ---- 569
    Mineral production 1893–1921, table showing total ---- 662
    Mining activities in ---- 102, 303
    Silver-lead mines in ---- 305
Magazines, on file in library ---- 134, 202, 252, 290, 349, 400, 488, 590, 724, 764
Magnesite:
    Imports and domestic production ---- 194
    in San Benito County ---- 218
        Tulare County ---- 529
    Occurrence ---- 190
    Output and value ---- 194
    Statistics, 1921 ---- 190–196
    Tariff on ---- 529
    Total production ---- 195
    Uses ---- 191
Magnesium salts, 1921 statistics ---- 383
Mahady prospect ---- 508
Mails and files ---- 30, 82, 127, 178, 238, 280, 326, 381, 428, 559, 632, 756

Page
- Malakoff Leasing Company 738
  - Mine 738
- Mammoth Mine 206
  - Copper Company 296
- Manganese:
  - Concentration of ores 46, 385
  - in San Benito County 219
  - in Tulare County 535
  - San Joaquin County, early production in 690
  - Statistics, 1921 384
- Manzanita Mine 320
- Map of Alleghany District 500
  - Bald Mountain Mine 525
  - Berryessa Valley, showing oil development 610
  - Silver Falls and Chicago Consolidated Mines 318
  - South Fork Mining District 315
- Marble, in Avawatz Mountains 115
  - Statistics, 1921 461
- Marguerite Mine 45
- Marin County:
  - Asphalt in 228
  - Bibliography of coal resources of 156
  - Mineral production, 1921 570
  - Mineral production, 1888-1921, table showing total 662
- Marine Chemical Company 383
- Marino Mine 21
- Mariposa County:
  - Bibliography of limestone deposits in 752
  - Mineral production 1921 570
  - Mineral production, 1880-1921, table showing total 664
  - Mining activities in 9, 144, 363
- Mariposa Grant 365
  - Mine 365
- Mines Association (see Ophir Mine).
  - Mine, Sierra County 508
- Marl (see limestone statistics 1921).
- Martin and Mocine 9
- Martin, E. L. Ranch Quarry 217
- Mary Mine (see Melvin).
- Mascot and West End Group 96
- Mascovich Mine 216
- Masonic District 415
  - Mines Association 415
- Massen Silver mines 743
- Master Quicksilver Furnace 424
  - Mining Company 424
- Mat Brader (see Brader Bros. Mine).
- Matrimony Mine (see Water Lily Mine).
- Mattern, Herman 97
- Matthews, John 215
- Maxine Mine 604
  - (See also Feather Forks and Maxine mines.)
- Maxwell, John, and Chas. Morgan 96
- Mayhall, Albert 9
- Merced County, oil development in 616
- McClave process, for oil sands 424
- McGilvray-Raymond Granite Company 305
- McKenzie-Minturn Mine 304
- McKittrick District, asphalt in 230
- McLean, J. E., claims of 3
- McMillan and Van Hook, limestone deposit 9
- Melvin, Mountain Lilly and Mary Mine 304
- Men employed in mineral industry, number of 429
  - Output of 430
- Memoranda on asphalt and bituminous sand deposits of California 228
- Mendocino County:
  - Bibliography of coal resources of 156
  - Limestone deposits in 752
  - Mineral production, 1921 571
  - Mineral production, 1880–1921, table showing total 666
  - Oil development in 372

Merced County: Page
    Bibliography of coal resources 156
    Mineral production, 1921 573
    Mineral production, 1880–1921, table showing total 668
    Mining activities in 8, 102
Merle Magnesia Company 383
Metallurgy of platinum 158–172
Metal mining in the Auburn District, 1922. Condition of 736–740
Metals, statistics, 1921 449–453
    Copper 450
    Lead 451
    Zinc 452
Mexican Mine 21
Mica, statistics, 1921 386
Middle Rand Silver Mining Company 104
Milkmaid and Franklin Group 43, 406
Mill and smelter of Afterthought Copper Company 596
Millenium Mine 304
Minarets and Western Railroad 102
Mina Rica Mine 21
Mine assessment year 234
Mineral compost 529
Mineral deposits or products for sale, list of 37, 91, 135, 203, 253, 292, 351, 402, 592, 726, 766
Mineral deposits or products wanted, list of 38, 91, 135, 203, 253, 293, 351, 402, 592, 726, 766
Mineral exhibit, in museum 33, 84
Mineral industry, number of men employed in 429
    Output per man employed in 430
Mineral leasing bill, state lands 122
Mineral paint, statistics, 1921 386
Mineral production in California:
    Estimate of, in 1921 31
    Industrial materials 472
    Salines 481
    Statistics, 1921 179–196, 239–245, 281–286, 327–344, 382–396, 429–485, 560–587
    Structural materials 453
    Summary, 1921 429
        Fuels 433
        Metals 449
    Table by counties, 1887–1921 560
            Years, 1887–1921 432
        San Benito County 213
        Total mineral yield of each county 634–719
        Tulare County 522
Mineral products for sale, list of 37, 91, 135, 203, 253, 402, 490
Mineral products wanted, list of 38, 91, 135, 203, 253, 402, 490
Mineral soap (see montmorillonite).
Mineral specimens catalogued 84–85, 129–130, 197–198, 246–247, 757–760
Mineral springs, in Tulare County 535
Minerals and Statistics, Division of 31–34, 83–88, 128–131, 176, 239–248, 281–287, 327–344, 382–397, 429–485, 560–587, 631, 623–719, 757–760
Minerals on stock-raising lands, location of 22
    in tide and submerged lands, leases on 122
Mineral Springs, radioactivity in gases at 545
Mineral water, in San Benito County 219
Mineral water, statistics, 1921 387
Mine report file 30, 82
Minnehaha Mine 221
Mining and oil property, valuation of 375
Mining and Scientific Press 27, 440
Mining assessment 236
Mining engineers, district reports of 5, 42, 96, 138, 206, 256, 295, 353, 405, 493, 595, 729
Mining Bureau Act 28
    Department 173
Mining location on stock-raising lands 22
Mining oil sands, proposed method and recovery of oil therefrom by flotation methods 273
Minnie Ellen Mine 527

Page
Miscellaneous stone, 1921 statistics ---- 465
  Crushed rock ---- 468
  Grinding mill pebbles ---- 467
  Paving blocks ---- 466
  Sand and gravel ---- 468
Mission Potteries Company ---- 557
Mizpah-Montana Mining Company ---- 104
Mizpah-Tonopah Mine ---- 221
Mocine and Martin ---- 9
Modoc County, bibliography of coal resources of ---- 156
  Mineral production, 1921 ---- 571
  Mineral production, 1880–1921, table showing total ---- 668
  Mining activities in ---- 295, 352
Mojave Mining District ---- 220, 307, 539
Mojave Rand Mining Company ---- 104
Mojave Rand Silver Corporation ---- 148
Mokelumne River, gold gravels of ---- 226
Molybdenum, 1921 statistics ---- 242
Monarch Mining Company ---- 105
  Mine, Tulare County ---- 538
Monkey Creek Mining Company ---- 295
Mono County:
  Activities in ---- 413
  Bibliography of coal resources of ---- 156
    Limestone deposits in ---- 752
  Mineral production, 1921 ---- 572
  Table showing total mineral production, 1880–1921 ---- 669
Mono Lake District (see Lundy and Mono Lake).
Mono Lake, gold in ---- 418
  Salts in ---- 417
Mono Mines Company ---- 415
Mono Recovery Company ---- 418
Monte Cristo Mine ---- 21
Monterey County:
  Activities in ---- 9
  Bibliography of coal resources of ---- 156
    Limestone deposits in ---- 752
  Mineral production, 1921 ---- 572
  Oil development in ---- 108, 312
  Table showing total mineral production, 1889–1921 ---- 670
Montmorillonite clays ---- 330
Montmorillonite, in San Benito County ---- 216
Monumental Mining District ---- 308
Moonshine claim ---- 510
Moore Hill District, Mariposa County ---- 364
Moore Mine ---- 299
Morgan, Chas., and John Maxwell ---- 96
Morganite in California ---- 332
Morington Mine ---- 604
Morning Glory Mine ---- 509
  Star Mine ---- 45
  Star Mine, Alpine County ---- 362
  Star Mine, Madera County ---- 304
  Sun claim ---- 510
Morris Ravine Drift Mine (see Butterfly Drift Mine).
Mother Lode bulletin, Progress report on ---- 78
Mother Lode district, New report on ---- 124–125
Mother Lode district (see Auburn Field division).
Mother Lode Highway ---- 7
Mountain Copper Company ---- 6, 42, 45, 296
Mountain Laurel Mine ---- 97, 297
Mountain Lilly Mine (see Melvin).
Mountain Lime Company ---- 148
Mountain View Mine ---- 304
Mountain View Quartz Mine ---- 354
Mount Pleasant Mine ---- 210, 301
Mount Shasta Silica Company ---- 96, 206
Mowry and Newman Mine (see Pitts Mine).
Mount Vernon Mine ---- 737
Mud Springs Mine ---- 304
Mugwump Mine ---- 143

Page

- Museum 31–32, 83, 128, 197, 246, 286, 344, 396, 484, 586, 720, 757
  - Specimens received and catalogued 84, 129, 197, 246, 287, 344, 757
- Myra Queen Mining Company 105
- Mystery metal, investigation of 87

- Napa Asbestos Quarries 419
- Napa County 46–752
  - Bibliography of coal resources of 156
    - Limestone deposits in 752
  - Geyser wells in 387
  - Ichthyol in oil from 107, 610
  - Mineral production 1921 573
  - Mining activities in 46, 419
  - Oil development in 51, 106, 108, 268, 312, 372, 426, 544, 608
    - Possibilities in Berryessa Valley 608
  - Table showing total mineral production, 1862–1921 672
- Napetro Producing Company, operations in Berryessa Valley 610
- Nash Mine 6
- National Cement Company 733
  - Kellastone Company (see Sierra Magnesite Company).
  - Mine 100
  - Parks, prospecting in 8
  - Research Council 26
- Natural Gas Fields 436
- Natural Gas, gasoline from 435
  - In San Benito County 219
  - In Tulare County 535
  - 1921 statistics 433
  - Soda Products Company 421
- Nelson, Geo. M. 158
- Nelson Mine 21
- Nevada County 7–752
  - Activities in 7, 45, 139, 261
  - Bibliography of limestone deposits in 752
  - Iron ore in 111
  - Mineral production 1921 573
  - Table showing total mineral production 1880–1921 674
- Nevada Wonder Mining Company 99
- New Citizen Mine 304
  - Idria Mine 220, 395
- Newman, M. A. 9, 13, 47, 104, 146, 220, 230, 264, 273, 307, 366, 419, 539, 554, 611, 740
- New publications 28, 80, 126, 177, 237, 279, 325, 380,427, 558, 632, 755
- New report on Mother Lode district 124–125
- Newspapers on file in library 291, 349, 401, 489, 591, 724, 764
- Newton Mining Company 738
- New York and Arcadia claims 736
- Niagara Mine 43, 296
- Nickel, 1921 statistics 243
- Nitrates, 1921 statistics 388
- Nixon Mine 21
- Noble Electric Steel Company property 6, 43, 600, 732
- Non-metallic minerals of southern California 13, 230, 554
- Norambagua Mine 7
- Normandie Dolmaine Mine (see Normandy Mining Company).
- Normandie Mine 737
- Normandy Mining Company 141
- Normile, Thos. 554
- North Chalone Peak, gold on 217
  - Rand Silver, Inc. 105
  - Star Mine 21, 272, 737
    - Mines Company 19, 20, 140, 513
  - Sumner Gold Mines 146, 539
- Northern California field division (see Redding field division).
- Notes from office of State Surveyor General 122
  - On iron ore occurrences in California 110–113
- Novello Mine 21
- Nugget Bar Placer Company 496
- Number of men employed in mineral industry 429
- Nyman Consolidated Mine (see Santa Ysabel Mine).

Page

- Oak Bottom Placer Syndicate 600
- Oat Canyon limestone deposit 529
- Official publications received in library, lists of 35, 89, 132, 200, 249, 288, 347, 398, 486, 588, 722, 762
- Oil (see petroleum also).
- Oil and gas development 10, 49, 106, 150, 223, 266, 311, 370, 425, 543, 615, 745
  - Supervisor, reports of 5, 10, 49, 106, 150, 223, 266, 311, 370, 425, 543, 615, 745
- Oil and mining property, valuation of 375
  - Field development operations:
    - in Alameda County 50
      - Colusa County 266
      - Fresno County 50, 150, 224, 266, 425, 615, 745
      - Humboldt County 425
      - Imperial County 150
      - Kern County 50, 106, 108, 150, 224, 266, 311, 370, 425, 615, 745
      - Kings County 51, 150, 745
      - Los Angeles County 51, 106, 108, 150, 224, 267, 311, 371, 425, 615, 745
      - Mendocino County 372
      - Merced County 616
      - Monterey County 108, 312
      - Napa County 51, 106, 108, 268, 312, 372, 426
      - Orange County 52, 108, 151, 225, 268, 312, 372, 426, 616, 746
      - Riverside County 151, 372, 617
      - Sacramento County 225
      - San Benito County 617
      - San Bernardino County 312, 372, 617
      - San Diego County 268
      - San Luis Obispo County 107, 268, 746
      - San Mateo County 52, 372, 426
      - Santa Barbara County 52, 107, 108, 151, 312, 372, 426, 747
      - Santa Clara County 52
      - Santa Cruz County 108
      - Sonoma County 52, 426
      - Stanislaus County 312
      - Tehama County 617
      - Tulare County 268, 312, 617
      - Ventura County 52, 108, 151, 225, 268, 312, 372, 426, 617, 747
- Oil possibilities in Berryessa Valley, Napa County 608
- Oil sands, analysis of 275
  - Mining of 10, 273, 424
  - Proposed method of mining and recovery of oil therefrom by flotation method 273
- Ojai Valley district, asphalt in 229
- Old Bader Mine (see Pitts Mine).
  - Daisy Mine (see Leroy Mine).
  - Elephant Gravel Mine 7
  - Mission Portland Cement Company 215, 218
  - Spanish Mine (see Golden Arrow Mining Company).
- Oliver Chemical Company 383
- Olympus Gold Mine 613
- Onyx and travertine, 1921 statistics 462
- Opal Mine 421
- Operating data, petroleum 443
- Ophir Mine 510
- Orange County 52–746
  - Bibliography of coal resources of 156
    - Limestone deposits in 752
  - Mineral production, 1921 573
  - Oil development in 52, 108, 151, 225, 268, 312, 372, 426, 544, 616, 746
  - Table showing total mineral production 1889–1921 676
- Ore treatment at the Belmont Shawmut Mine, Tuolumne County 748
- Organization chart of State Mining Bureau 630
- Oriental Gold Mining Company 511
  - Mine 511
- Oriflame Prospect 517
- Original Sixteen to One Mining Company (see Sixteen to One Mine).
- Oro Fina Mine 738
  - Mining Company 7
- Oro Grande Mine (see Strode Mine).
- Oro Mine 737

Page
Osceola Group ---- 511
  Mine ---- 142
  Mining Company ---- 738
Osmium (see metallurgy of platinum).
Otaylite ---- 330
Outlook for 1922, petroleum ---- 438
Output of men employed in mineral industry ---- 439
Ozark Gravel Mine ---- 99
  Mine ---- 272

Pacific Asbestos Corporation ---- 93
  Clay Products Company ---- 264
   Plants of ---- 265
  Coast Borax Company ---- 611, 741
  Coast, iron industry on ---- 188–190
   Steel Company ---- 218
Pacific Gold Dredging Company ---- 258, 297, 603
  Porcelain Ware Company ---- 556
  Sanitary Manufacturing Company ---- 263
  Sewer Pipe Company (see Pacific Clay Products Company).
Paddy Cronin Placer group ---- 495
  Pride Mine ---- 611
Page, N. D., Ranch, diatomaceous earth on ---- 217
Palladium in Yuba County ---- 719
Palladium (see metallurgy of platinum).
Palmtag, Leopold, property ---- 217, 218
Paragalia Mining Company (see Blue Hog Mine).
Parker's Plant, Professor, at Mono Lake ---- 418
Parole Mine ---- 101
Patriquin Quicksilver Mine ---- 9, 421
Patterson District ---- 414
  Mine ---- 100
Paving blocks (see miscellaneous stone).
Paymaster Mine ---- 47, 101
Peerless Group of Mines ---- 598
Pellucca Placer Mine ---- 354
Penn-California Gravel Mine ---- 45
  Mining Company ---- 142
Pennewell & Co. ---- 529
Penolay Ranch Mine ---- 300
Personnel, changes in ---- 30, 633
Peterson, T. P., claims ---- 206
Petroleum (see oil also):
  Department ---- 175,629
  Early production in Los Angeles County ---- 665
   Ventura County ---- 716
Petroleum, 1921 statistics ---- 436–449
  Average price per barrel ---- 439
  Capitalization of industry ---- 446
  Dividends paid by oil companies ---- 447
  Financial and operating conditions ---- 443
  Operating data ---- 443
  Outlook for 1922 ---- 438
  Proved oil land ---- 449
  Specific gravity of oils produced ---- 441
  Total production of California ---- 439
  Well operations, by fields ---- 441
Petroleum and natural gas in San Benito County ---- 219
Philadelphia Exploration Company ---- 736
Phoenix Mining Company ---- 105
Phosphate rock from oil well in Kings County ---- 287
Phosphates, 1921 statistics ---- 389
Pine Nut Mine ---- 603
Pinmore Mining Company ---- 105
Pioneer Brick Company ---- 523
  Mine ---- 302, 738
  Mining Company ---- 302
Pittsburg-Comstock Company ---- 601
Pittsburg-Liberty Mine ---- 415
Pittsburgh-Mount Shasta Mining Company ---- 105, 139
Pitts Mine ---- 260

Page

- Placer County ---- 7–752
  - Activities in ---- 7, 45, 211, 261, 301, 602
  - Bibliography of coal resources of ---- 156
    - Limestone deposits in ---- 752
  - Iron ore in ---- 111
  - Mineral production 1921 ---- 574
  - Table showing total mineral production 1880–1921 ---- 678
- Placer gold investigation progress report on ---- 78, 123, 226, 373, 550
  - Resources ---- 11
- Placers, dry, of southern California ---- 321
- Plant of Feather-Stone Insulation Company ---- 367
- Platinum in Hayford Creek ---- 298
  - In Plumas County ---- 7
  - In San Mateo County ---- 9
  - Metallurgy of ---- 158–172
  - 1921 statistics ---- 389
- Plumas County ---- 6, 752
  - Activities in ---- 6, 7, 604
  - Bibliography of coal resources of ---- 156
    - Limestone deposits in ---- 752
  - Iron ore in ---- 111
  - Mineral production 1921 ---- 574
  - Table showing total mineral production 1880–1921 ---- 680
- Plumas Eureka Annex Company (see also Jamison Mine) ---- 605
  - Mine ---- 605
- Plumbago Mine ---- 143, 512
- Plymouth Mine ---- 301
- Pockets, in Sixteen to One Mine ---- 515
- Point Arena District, asphalt in ---- 228
- Positions open, list of ---- 491
  - Wanted, list of ---- 39, 92, 136, 204, 254, 294, 352, 403, 491, 593, 727, 767
- Potash from Owens Lake ---- 420
- Potash, 1921 statistics ---- 391
- Pottery Clay (see clay).
- Pottery Industry, cited ---- 555
- Preface ---- 41, 95, 137, 205, 255, 294, 352, 404, 492, 594, 728
- Pre-volcanic channels ---- 551
- Price Mine ---- 21
- Price of oil per barrel 1914–1921 ---- 439, 448
- Princeton Mine ---- 365
- Producer gas, bibliography of manufacture, from California coals ---- 155
- Producers and consumers ---- 37, 91, 135, 203, 253, 292, 351, 402, 490, 592, 726, 766
- Production, California minerals, estimate for 1921 ---- 31
  - Statistics 1921 ---- 179–196, 239–245, 281–286, 327–344, 429, 484
    - Aluminum ---- 239
    - Antimony ---- 240
    - Arsenic ---- 249
    - Asbestos ---- 179
    - Asphalt ---- 327
    - Barytes ---- 183
    - Bismuth ---- 240
    - Bituminous rock ---- 183
    - Borax ---- 281
    - Brick and tile ---- 454
    - Cadmium ---- 241
    - Calcium chloride ---- 482
    - Cement ---- 282
    - Chromite ---- 284
    - Clay (pottery) ---- 473
    - Coal ---- 184
    - Cobalt ---- 242
    - Copper ---- 450
    - Dolomite ---- 327
    - Feldspar ---- 328
    - Fluorspar ---- 185
    - Fuller's earth ---- 329
    - Gems ---- 331
    - Gold ---- 333
    - Granite ---- 458
    - Graphite ---- 186

Page

    - Gypsum 338
    - Infusorial and diatomaceous earth 339
    - Iron ore 187
    - Lead 451
    - Lime 340
    - Limestone 340
    - Lithia 382
    - Magnesite 190
    - Magnesium salts 383
    - Manganese 384
    - Marble 461
    - Mica 386
    - Mineral paint 386
    - Mineral water 387
    - Miscellaneous stone 465
    - Molybdenum 242
    - Natural gas 433
    - Nickel 243
    - Nitrates 388
    - Onyx and travertine 462
    - Petroleum 436
    - Phosphates 389
    - Platinum 389
    - Potash 391
    - Pumice and volcanic ash 392
    - Pyrites 196
    - Quicksilver 393
    - Salt 482
    - Sandstone 463
    - Serpentine 464
    - Silica (sand and quartz) 477
    - Silver 343
    - Slate 464
    - Soapstone and talc 478
    - Soda 484
    - Strontium 480
    - Sulphur 480
    - Summary 429
    - Tin 243
    - Tungsten 244
    - Vanadium 245
    - Zinc 453
- Progress report on Mother Lode bulletin 78
  - Placer gold investigation 78, 123, 226, 373
- Progressive Placer Mine 496
- Proposed method of mining oil sands and recovery of oil therefrom by flotation Methods 273
- Prospector, rights of, on stock raising lands 22
- Prouty, T. C., Pottery Company 557
- Proved oil lands 449
- Public schools, mineral collections sent to (see museum).
- Publications, distribution of 29, 81, 126, 177, 237, 279, 325, 380, 427, 558, 632, 755
  - New 28, 80, 126, 177, 237, 279, 325, 380, 427, 558, 632, 755
  - Official, received in library 35, 89, 132, 200, 249, 288, 347, 398, 486, 588, 722, 762
- Pumice and volcanic ash, 1921 statistics 392
- Pure Gold Mining Company 304
- Pyrites, 1921 statistics 196
- Quail Mine 365
- Quaker Hill Mines Company 738
- Quartz (see Silica).
- Quartzburg District, Mariposa County 365
- Quartz Creek Dredging Company 103
  - Hill Mine 354
  - Mining in the Alleghany District 499
    - Geography 499
    - Geology 499
    - Mines 502-519
    - Power 499
  - Mountain Mine 304
- Quicksilver in San Benito County 219
  - In San Luis Obispo County 424

Page
Quicksilver, new equipment at mines 395
  1921 statistics 393
  Proposed tariff on 394
  Total production of 396
  Uses of 395
Quien Sabe Mine 214

Radamaker District 147
Radioactive mineral, from Imperial County 247
Radioactivity in mineral springs waters 387
  In thermal gases at the geysers, Sonoma County 545
Ragesdale Mine 304
Rainbow Mine 143, 513, 733
  Extension Mine 513
Rancho El Gabilan, asphalt on 214
Randolph Consolidated Gold Mining Company 142
Randsburg District 9, 49, 104, 147, 221, 222, 265, 309, 368, 422, 539
  Silver Mining Company 105, 148, 266, 370, 613, 744
Rand Silver Mining Company 105
Rawhide Mine 101, 302, 738
Raymond Granite Company 305
Recovery of oil by flotation methods, and proposed method of mining oil sands 273
Redding, Allen C. 158
Redding Field Division 5, 30, 42, 96, 138, 206, 256, 295, 353, 405, 493, 595, 729
Redfield Mine (see Last Chance).
Red Hill Mine 739
Red Wing Mine 301
Reed, Chas., and J. C. Gaither 295
Refiners Clay Company 9
Reid Mine 408
Report on Mother Lode District, new 124-125
Rhodium (see metallurgy of platinum).
Rhodonite in California 332
Ricard, T. A., cited 27
Riggs Mine 223
Rights of locator, on stock-raising lands 22
Rincon Mines Company 308
Rip Van Winkle Mine 214
Rising Ranch well, gas in (see Golden State Property well).
  Star Mine 411
  Sun group 513
    Mine 7
Riverside County 111-752
  Bauxite from 198
  Bibliography of coal resources of 156
  Limestone deposits in 752
  Gypsum in 231
  Iron ore in 111
  Mineral production, 1921 575
  Mining activities in 221, 224
  Oil development in 151, 372, 544, 617
  Table showing total mineral production, 1891-1921 689
Riverside Mine 21
  Portland Cement Company 529
Robertson, E. M., and S. Carpenter 97
Rock, bituminous, 1921 statistics 183-184
Rocky Point Granite Quarry 527
Roosevelt Mine 297
Roff, Lewis 97
Rubies, in San Bernardino County 86
Ruby Pearl Mine 354
Rue, James O. 102
Russell, Dan, et al. 7
Russell Ranch, prospecting on 101
Rutheniam (see metallurgy of platinum).
Rutherford Mine (see Bella Union).
Ruth Pierce Quartz Mine 365

Sacramento and Texas drift claims 263
Sacramento County 156-682
  Bibliography of coal resources of 156
  Mineral production 1921 576
  Oil development in 225
  Table showing total mineral production, 1880-1921 682

Page
Salines, 1921 statistics 481-484
  Calcium chloride 482
  Salt 482
  Soda 484
Salinas Valley District, asphalt in 229
Salt, 1921 statistics 482
  Basin area, Avawatz Mountains 117
  In Avawatz Mountains 116
  In Mono Lake 417
Samples determined in laboratory, lists of 34, 86, 131, 198, 248
Sampson Magnesite Company 218
San Benito Coal Mining Company 145, 216
San Benito County 9-753
  Activities in 9, 46, 145, 211, 220
  Bibliography of coal resources of 156
    Limestone deposits in 753
  Geography and geology 212
  Iron ore in 111
  Mineral production, 1921 576
    Table 213
    Resources 212
  Oil development in 617
  Table showing total mineral production, 1865-1921 684
San Benito Gem Company 217
  Magnesite Company 219
  Mineral Spring Company 219
  Quarries Company 217
  Vineyards Company quarry 217
San Bernardino County 9-753
  Activities in 9, 49, 104, 148, 222, 265, 308, 368, 422, 539, 611, 742
  Bibliography of coal resources of 156
    Limestone deposits in 753
  Economic minerals of Avawatz Mountains in 114
  Gypsum in 232
  Iron ore in 112
  Mineral production, 1921 576
  Oil development in 312, 372, 544, 617
  Rubies in 86
  Table showing total mineral production, 1880-1921 689
Sanborn, Frank 33, 85, 130, 158, 198, 247, 287, 345, 397,485, 587, 720, 761
Sand and Gravel (see Miscellaneous Stone).
  Quartz (see Silica).
San Diego County 49-753
  Bibliography of coal resources of 156
    Limestone deposits in 753
  Iron ore in 112
  Mineral production, 1921 577
  Mining activities in 49, 106, 149, 223, 542
  Oil development in 268
  Table showing total mineral production, 1880-1921 686
San Domingo Quartz Mine 365
Sandstone, 1921 statistics 463
San Fernandez Mine 737
San Francisco County 146-753
  Activities in 146
  Bibliography of coal resources of 156
    Limestone deposits in 753
  Mineral production, 1921 578
  Table showing mineral production, 1894-1921 688
San Francisco field division 8, 45, 101, 143, 211, 263, 303, 363, 413, 519, 608, 740
Sanguinetti Gravel Mine 98
San Joaquin County 157-753
  Bibliography of coal resources of 157
    Limestone deposits in 753
  Mineral production, 1921 578
  Table showing total mineral production, 1885-1921 690
San Justo Ranch, clay deposit on 215
San Luis Obispo County 10-753
  Activities in 10, 424
  Bibliography of coal resources of 157
    Limestone deposits in 753

Page

  - Iron ore in — 112
  - Mineral production, 1921 — 578
  - Oil development in — 107, 268, 746
  - Table showing total mineral production, 1876-1921 — 693
- San Luis Obispo district, asphalt in — 229
- San Mateo County — 9-753
  - Bibliography of coal resources of — 157
    - Limestone deposits in — 753
  - Mineral production, 1921 — 579
  - Mining activities in — 9, 46
  - Oil development in — 52, 372, 426, 544, 747
  - Table showing total mineral production, 1895-1921 — 694
- Santa Barbara County — 52-753
  - Asphalt in — 229
  - Bibliography of coal resources of — 157
    - Limestone deposits in — 753
  - Mineral production, 1921 — 579
  - Oil development in — 52, 107, 108, 151, 312, 372, 426
  - Table showing total mineral production, 1881-1921 — 699
- Santa Clara County — 102-753
  - Asphalt in — 229
  - Bibliography of coal resources of — 157
    - Limestone deposits in — 753
  - Mineral production, 1921 — 580
  - Mining activities in — 102
  - Oil development in — 52, 544
  - Table showing total mineral production, 1850–1921 — 699
- Santa Cruz County — 108–753
  - Bibliography of coal resources of — 157
    - Limestone deposits in — 753
  - Mineral production, 1921 — 580
  - Oil development in — 108
  - Table showing total mineral production, 1894–1921 — 696
- Santa Cruz district, asphalt in — 228
- Santa Maria district, asphalt in — 229, 230
- Santa Ysabel Mine — 101
- Savannah Mine — 304
- Sawyer Mine — 21
- Scorpion Mine — 21
- Secretary of the Interior, instructions from — 24
- Secretary's office, report of — 28, 80, 126, 173, 237, 279, 325, 380, 427, 558, 628, 755
- Serita property — 415
- Serpentine, 1921, statistics — 464
- Seven Thirty Mine (see Alcalde).
- Shadows Creek Hydraulic Mine — 733
- Shasta County — 6–753
  - Activities in — 6, 42, 96, 138, 206, 256, 295, 353, 405, 493, 595, 729
  - Bibliography of coal resources of — 157
    - Limestone deposits in — 753
  - Iron ore in — 112, 732
  - Limestone in — 733
  - Mineral production, 1921 — 580
  - Silver lodes of the South Fork Mining district — 313
  - Table showing total mineral production, 1880-1921 — 699
- Shasta Dredging Company — 6, 207, 297
  - Hills Mining Company — 138, 408
  - Iron Company — 353
    - Mine — 600, 732
  - Mines and Reduction Company — 495
    - (see also Mount Shasta Silica Company).
  - Zinc and Copper Company — 43, 256, 353, 410, 733
- Sheep Creek area, Avawatz Mountains — 117
- Sherwood, C. F. — 87
- Shoshonite — 330
- Shrine Convention, California minerals exhibited during — 275
- Sierra Buttes–Bigelow Consolidated mines — 737
- Sierra County — 112–753
  - Activities in — 143
  - Bibliography of limestone deposits in — 753
  - Iron ore in — 112
  - Mineral production, 1921 — 581
  - Quartz mining in the Alleghany district — 499
  - Table showing total mineral production, 1880-1921 — 698

Page

- Sierra Highland Mine 737
  - Magnesite Company 8, 531
    - Flow sheet of calcining plant 533
  - Slate Company 602
  - Talc Company (see Inyo Talc Company).
- Silica (sand and quartz), 1921 statistics 477
- Silver, 1921 statistics 343
  - Average price 1914–1920 343
  - in Tulare County 537
- Silverado property (see Mono Mines Company).
- Silver Bar Mining Company 105
    - and Reduction Company 147
  - Bell Mining Company 542
- Silver Bow Mine 613
  - Contact mine 49
  - Dyke Group 49
    - Mining Syndicate 105
  - Falls and Chicago Consolidated mines 316, 354, 413
    - map of 313
  - Horde Mine 305
  - King Mining Company 105
  - Lake Mining Company 105
  - Lead Mine (see Simpson Mining Company.)
  - Lodes of the South Fork Mining District, Shasta County 313
    - Acknowledgment 316
    - Conclusions 316
    - Description of mines 316
    - Geology 314
    - History 313
    - Topography 313
    - Water, timber and power 316
  - Moon Mining Company 105
  - Mountain District, Alpine County 360
  - Reef claims 105
  - Wave Mining Company 105
- Simpson Mining Company 365
- Sinclair, Geo. V. 301
- Siskiyou County 6–753
  - Activities in 6, 96, 139, 206, 256, 297, 354, 495, 600, 733
  - Bibliography of coal resources of 157
    - Limestone Deposits in 753
  - Iron ore in 112
  - Mineral production, 1921 581
  - Table showing total mineral production, 1880–1921 700
- Sixteen to One Mine 143, 514
- Slab Ranch Gravel Mine 99
- Slate, 1921 statistics 464
  - Quarries in El Dorado County 602
- Smelter and mill of Afterthought Copper Company 596
- Smelter, Bully Hill 411
- Smelting of iron ores on Pacific Coast 188-190
- Smith, A. B., Leasing Company 416
- Smith, Ed. 105
- Smith, George Otis 25
- Smith, R. M., tract, oil sands on 10
- Snowden Hill Mine 737
- Soap Root Mine 21
- Soapstone and talc, 1921 statistics 478
- Soda, 1921 statistics 484
  - Ash 420, 421
  - Bicarbonate 421
- Solano County 157–753
  - Bibliography of coal resources of 157
    - Limestone deposits in 753
  - Mineral production, 1921 582
  - Table showing mineral production, 1873–1921 702
- Sonoma County 52–753
  - Bibliography of coal resources of 157
    - Limestone deposits in 753
  - Iron ore in 112
  - Mineral production, 1921 582
  - Oil development in 52, 426
  - Table showing total mineral production, 1873–1921 704

Page
Southern California, dry placers of 321
  Non-metallic minerals of 13, 230, 554
South Fork Mining District, Shasta County, silver lodes of 313
  Map of 315
  Rand Mines Company 424
South Star Gold Mines Company 261
  Mines 256
Southwestern Portland Cement Company 215
S. P. Brick Company 523
Special articles 11, 53, 109, 152, 226, 270, 313, 373, 545, 618, 748
Specific gravities of oils produced 441
Specimens received and catalogued for museum
  84–85, 129–130, 197–198, 246–247, 287, 344–345, 757–760
Springfield Tunnel and Development Company 101
Spring Gulch Mine 21, 101
Spring Mine 139
Spurr, J. E. 25
St. Adel Mining Company (see Blue Gravel Mine).
Stampeder Mining Company 105
Standard Gold Mining Company 221
  Mine 21, 417
  Oil Bulletin, cited 439, 443
  Portland Cement Company 46
  Pottery (see Mission Potteries Company).
  Unit Mine 210
Stanislaus County 103–706
  Activities in 103
  Bibliography of coal resources of 157
  Mineral production, 1921 583
  Oil development in 312
  Table showing total mineral production, 1880–1921 706
Stanislaus River, gold gravels of 226
Starbuck Mine 304
Star City Group 495
Star Mine 305
Starlight Group 304
  Of the West Mine 21
State Surveyor General, notes from office of 122
Statistics, mineral, 1921
  31, 83, 128, 179–196, 239–248, 281–287, 327–344, 382–397, 429–485, 560–587, 757
  Tables showing total mineral yield of each county 634–719
Stauffer Chemical Company 733
Stayton Mining Company 306
Steam, utilization of, from well at The Geysers, Sonoma County 546
Steatite (see soapstone and talc).
Steger Mine 21
Steifer Mine 261
Stencil Mine 527
St. Gabriel Mine (see Simpson Mining Company).
Stock Asbestos mines 296
Stock-raising lands, mining location on 22
Stone industry in San Benito County 220
Strickling, Almond 97
Strode Mine 207, 600
  Mines Company 257
Strontianite (see strontium).
Strontium, 1921 statistics 480
Structural materials, 1921 statistics 453
  Brick and tile 454
  Granite 458
  Marble 461
  Miscellaneous stone 465
  Onyx and travertine 462
  Sandstone 463
  Serpentine 464
  Slate 465
Stud Horse Flat Group (see White Oak Mine).
Success Mine 416
Sugar Loaf Oil Company, operations in Berryessa Valley 610
  Pine Lumber Company of California, railroad construction by 102
Sulphur, 1921 statistics 480
  Bank Quicksilver Mine 9, 395, 481

Page

- Sultana Mine 142
- Summary, mineral production California in 1921 429–484
- Summit Copper Co. 733
  - Mine 206, 256
- Sunset district, asphalt in 230
  - Mine 527
- Sunshine Group 295
  - Mine 307, 353
  - Mines 422
- Surcease Mine 261
- Sutter County 157–753
  - Bibliography of coal resources of 157
    - Limestone deposits in 753
  - Mineral production, 1921 583
  - Table showing total mineral production, 1908–1921 707
- Sybel and Niagara mines 43
  - Mine 138, 296, 408

- Table, comparative value of mineral production of counties, 1920 and 1921 431
  - Counties, 1920 and 1921 431
    - Yield of mineral substances, 1920 and 1921 430
    - (See also under each substance).
  - Mineral production of San Benito County 213
    - Of Tulare County 522
    - 1921, by counties 560
  - Miscellaneous stone production by years 472
  - Total mineral production of California by years 432
  - Showing total mineral yield of each county 634–719
- Table Mountain Mining Company (see Butterfly Drift Mine).
- Tabulated data on West Point mines 21
- Talc (see soapstone and talc).
  - In Avawatz Mountains 114
  - In Inyo County 421
- Tanner Mine 98
- Tariff on magnesite 529
- Tar Sands, mining of 424
- Taxation, valuation of mining and oil property for 377
- Taylor Mine 210
- Tecopa Consolidated Mining Company 611
- Tehama County 112–708
  - Activities in 355, 496
  - Bibliography of coal resources of 157
  - Iron ore in 112
  - Mineral production, 1921 583
  - Oil development in 617
  - Table showing total mineral production, 1880-1921 708
- Tertiary channels 553
  - Sluice robbers 550
- Texas Consolidated Group 206
  - Drift Claim (See Sacramento and Texas).
  - Flat Mine 304
  - Hill Mining Company 365
- Thayer, W. W. 28, 80, 126, 173, 237, 279, 325, 380, 427, 558, 628, 755
- The Geysers, Sonoma County, analysis of gas from 549
  - Radioactivity in thermal gases at 545
  - Utilization of steam from well at 546
- Thoroughbred Mining Company 740
- Tickner, W. L., and A. G. Brown 97
- Tightener Mine 143, 517
- Tile (see Brick and tile).
- Tin, 1921 statistics 243
- Tin ore in Tulare County 9
- Titanic Mining Company 263
- Tonopah Mining Company 99, 503
- Tourmalines in California 332
- Trafton Mine (see Mascovich).
- Trask, Dr. John B., cited 361
- Travertine (see onyx and travertine).
- Travertine in Mono County 417
- Treasure Hill Mine 542
  - Mining Company 300
- Trinity Bonanza King Mine 257

Page

- Trinity County 6–753
  - Activities in 6, 43, 97, 139, 207, 257, 297, 355, 496, 600, 733
  - Bibliography of coal resources of 157
    - Limestone deposits in 753
  - Mineral production, 1921 584
  - Table showing total mineral production, 1875–1921 710
- Trinity Gold Dredging Company 297, 601, 734
  - Hydraulic Gold Mining Company, Ltd. 6
  - Mohawk Group 298
    - Mine 498
- Triple Lode Mine 98
- Tripolite (see infusorial and diatomaceous earths).
- Tri-state Mining and Development Company 361
- Troilite in Del Norte County 131
- Trona, crude (see Inyo Development Company).
- True Friend Mine 47
- Tucker, W. Burling 30, 42, 96, 114, 138, 206, 256, 270, 295, 313, 354, 405, 493, 595, 729
- Tulare County 8–754
  - Bibliography of limestone deposits in 754
  - Lime phosphate in 587
  - Mineral production, 1921 584
    - Table 522
  - Mineral resources 520
  - Mines 523-538
  - Mining activities in 8–9, 47, 519–538
  - Occurrence of anapaite in 720
  - Oil development in 268, 312, 544, 617
  - Table showing total mineral production, 1880-1921 712
- Tulare Farms Property well, gas in 537
  - Lake district, natural gas in 535
- Tungsten, 1921 statistics 244
  - In Madera County 306
- Tuolumne County 99–754
  - Activites in 99
  - Bibliography of limestone deposits in 754
  - Mineral production, 1921 585
  - Table showing total mineral production, 1880–1921 714
- Turquoise in California 332
- Tuscan Oil Company 355, 496
- Twenty-one Mine (see Sixteen to One Mine)..

- Uncle Billy Rogers Mine 361
- Underwood, H. V. 214
- Underwood lignite prospect 9
- Union Hill Placer Mine 207
  - Hydraulic Mine 97
  - Mine 210
- Unity Hydraulic Mine 496
- U. S. Bureau of Mines 22, 25
  - Geological Survey 26, 31, 333, 335, 336, 343, 440
  - Shipping Board 26
  - Smelting, Refining and Mining Company 6, 96, 138, 495

- Valdor dredge 297
  - Dredging Company 6, 139
- Valley salt area, Avawatz Mountains 117
  - View Products Company 603
    - Analysis of water from property of 603
- Valuation of mining and oil property 375
- Vanadium, 1921 statistics 245
- Vanadium Gold Company 310
- Vancouver Pinnacles, copper near 216
- Vandalia Mine 301
- Vanderbilt District 9
  - Mining Company 614
- Vanderleck, L. 219, 228
- Van Hook and McMillan, limestone deposit of 9
- Vaughn, L. W., copper claims 296
- Venicia Mine 207, 497
- Ventura County 52–754
  - Bibliography of limestone deposits in 754
  - Mineral production, 1921 585
  - Oil Development in 52, 108, 151, 225, 268, 312, 372, 426, 544, 617, 747
  - Table showing total mineral production, 1880–1921 716

Page

- Verdun claims 101
- Victor Gravel Mine 99
- Victoria Mine 422
- Victory Gold Mining Company 600
- Vienna Mining Company 105
- Visalia Masonic Mining Company 415
- Vitrified Products Company 223
- Volcanic ash (see pumice and volcanic ash).
- Volcano No. 1 Mine 305
- Von Kotsch and Moore 301

- Wage scale in Alleghany District, Sierra County 737
- Wagman and McFarland property 220
- Walker Copper Mine 605, 736
- Walker, Frank, pocket from claim of 296
- Walker Mine, Placer County 738
- War minerals investigation 25
  - Relief act 8–24
    - Claimants, statement to 24
- Warner Barnes & Company (see Bald Mountain Mine).
- Wartman, A. L., platinum claims 7
- Washington Development Company 138
  - Mine 43, 138, 305
- Water, analysis of Valley View Products Company's 603
- Water Commission 3
  - Lily Mine 21
- Waterloo and Consolidated Four mines 305
- Waterman Mine 542
- Well operations by fields, 1921, petroleum 441
- Wells, natural gas in, Tulare County 535
- West Coast Asbestos Company 368
  - Porcelain Manufacturers 46
  - Porcelain Company 556
- West End and Mascot Group 96
  - Area, Avawatz Mountains 117
  - Mine 256, 295, 409
- Western Exploration Company 407
- West Point District 15–21
  - Character of the ore deposits 16
  - Geography 15
  - Geology 15
  - History of mining development 16
  - Mines of 18
    - Tabulated data on 21
- West Side prospect 301
  - Walker River district 414
- White Horse Mine 538
  - Metal, investigation of 86
  - Oak Mine 144, 366
  - River mining district 524
  - Star Silver group of mines 319
- Whiting-Mead Company 557
- Whitney Chemical Company 383
- Whittaker plant at Mono Lake 418
- Wide West Mine 21
- Wildcat Mining Company 105
- Wild Irishman Mine 257
- Williams Ranch Well, gas in 536
- Wilshire Mine (see Bishop Creek Milling Company).
- Wolf Creek Mine 361
- Wonder Mine 519
- Wood Estate Company 736
- Woodhouse Mine 21
- Wreden Oil Company, operations in Berryessa Valley 610

- Yale, Chas. G., cited 333, 335, 336, 343
- Yankee Hill Gold Mining Company 103
  - John Mine 495
- Yellow Aster Mine 272
    - Mining and Milling Company 105, 147, 539
  - Dog Mining Company 307, 539
  - Jacket Mine 273

Page

Yellowstone Mine 272
Yolo County 157–754
  Bibliography of coal resources of 157
    Limestone deposits in 754
  Mineral production, 1921 586
  Table showing total mineral production 1873–1921 718
Young America Mine 737
Yuba County 586–754
  Activities in 606
  Bibliography of limestone deposits in 754
  Mineral production, 1921 586
  Table showing total mineral production, 1880–1921 719
Yuba Development Company 740
  Dredge, exhibited at shrine convention 278
  Gold Mining Company 607
  Mine 738
  River, gold gravels of 226

Zantgraf Mine 210
Zinc, 1921 statistics 453
Zinc-lead in Tulare County 538
Zinc oxide plant of Shasta Zinc and Copper Company 411
Zulu Mine 305

o

17105 3-23 750

131787

UNIVERSITY OF CALIFORNIA, DAVIS
3 1175 02570 9323